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Two Essays on the Accounting Treatment for Information Technology Expenditures

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TWO ESSAYS ON THE ACCOUNTING TREATMENT FOR INFORMATION TECHNOLGY EXPENDITURES

TWO ESSAYS ON THE ACCOUNTING TREATMENT FOR INFORMATION TECHNOLOGY EXPENDITURES

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of the requirements for the degree of
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ABSTRACT

The current accounting measurement and reporting system is ill-equipped to provide intangible investment information that is decision useful for stakeholders in the information economy. Potentially relevant intangible items are not reported on the balance sheet, since current standards mandate the immediate expensing of these intangible items. Presumably FASB's uncertainty with the fundamental issues of extent and timing of future benefits to the firm has led to concerns with relevance, reliability, and objectivity of capitalizing some intangibles, which results in potential long term value generating expenditures being immediately expensed on the income statement. Prior research has demonstrated extent and timing of some income statement intangibles, such as advertising and research and development, however the potential value of IT intangibles as an asset has not been investigated.

This dissertation addresses issues on the accounting treatment for information technology (IT) expenditures and includes two parts. The first part contains an essay discussing the business value of IT expenditures using a rational economic argument to propose the capitalization of IT expenditures as an appropriate accounting treatment. The second part is composed of an essay that proposes statistically reliable amortization rates for intangible IT expenditures followed by a value analysis of the proposed accounting treatment.

This dissertation provides information about the business value of capitalized information technology. The results of this study could help standard setters (FASB, IASB), other policy makers and regulators (SEC, Fed Res Board), firm managers, and financial statement users refine standards for intangible assets, specifically information technology.

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DEDICATION

This dissertation is dedicated to the village it took to raise this PhD student. My family supported me and covered for me so that I could pursue my dream. Eric, Tanner, Kyndel, Mom, Dad, Stacey, and Uncle Dan, we did it!

Graduate school friends are the ones that walk through the trenches together. They are a group bound together by a common experience, never to be forgotten. These six women will be my sisters for as long as I am on this earth. On days when I thought I could not walk another step forward, you all pushed, pulled, or carried me until I regained my strength. Julie's altruistic acts will be rewarded for a lifetime to come. Angela's unwavering and unconditional support brings a smile to my face each morning. Maureen's introduction to the Lord serves me to this day. Elyria's ability to share the meaning of prayer overwhelms me with its power, especially when it includes her circle. Pam's willingness to listen tirelessly to my ideas will always be reciprocated. Georgia just speaks my language. You are my biggest fans!

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Chapter 1

TWO ESSAYS ON THE ACCOUNTING TREATMENT FOR INFORMATION TECHNOLGY EXPENDITURES

I. INTRODUCTION

This dissertation addresses issues on the accounting treatment for information technology (IT) expenditures and includes two parts. The first part contains an essay discussing the business value of IT expenditures using a rational economic argument to propose the capitalization of IT expenditures as an appropriate accounting treatment. The second part is composed of an essay that proposes statistically reliable amortization rates for intangible IT expenditures followed by a value analysis of the proposed accounting treatment.

The current accounting measurement and reporting system is ill-equipped to provide intangible investment information that is decision useful for stakeholders in the information economy. Potentially relevant intangible items are not reported on the balance sheet, since current standards mandate the immediate expensing of these intangible items. Presumably FASB's uncertainty with the fundamental issues of extent and timing of future benefits to the firm has led to concerns with relevance, reliability, and objectivity of capitalizing some intangibles, which results in potential long term value generating expenditures being immediately expensed on the income statement. Prior research has demonstrated extent and timing of some income statement intangibles, such as advertising and research and development, however the potential value of IT intangibles as an asset has not been investigated.

The first study investigates the business value of IT. The business value of IT refers to the organizational performance impacts of IT expenditures including productivity enhancements, profitability improvements, market value, and other measures of firm performance (Melville et al, 2004). Researchers in the last decade have found large productivity improvements associated with IT, as well as evidence that IT contributes to the market value of the firm. However, the question still remains whether IT has a positive impact on profitability. The focus of this essay is to establish a theoretical link between productivity, profitability, and market value, resulting in a rational economic argument for capitalizing IT intangibles. Applying methods based on economic theory, this paper examines the rationally managed, profit maximizing behavior of firms in competitive markets. This analysis suggests firms will optimize production plans and precisely measure IT costs as assets to maximize profits and stock market value.

The second essay empirically examines the asset behavior of IT expenditures, proposes a useful life and amortization rate estimates for a capitalization treatment of IT intangibles, and then examines the value of the capitalized intangible IT information to investors by associating contemporaneous equity market values and intertemporal stock returns with constructed IT book value amounts. The sample is comprised of 1633 U.S. firm year observations from *InformationWeek 500* surveys for the period 1991-1997 and industry spending information from *InformationWeek 500* surveys for the period 1998-2006. The results of this analysis demonstrate the intangible component of IT expenditures is associated with future operating income, which is then used to establish a proposed amortization rate based upon the identified positive association between IT and earnings in future periods. A positive and significant association exists between the book and market values in a contemporaneous setting, consistent with information valued by investors for decision making. A positive and significant association exists between the constructed intangible component of IT expenditures and future returns, consistent with investor mispricing due to lack of useful and or available information for decision making. These results imply the investor is valuing the IT expenditure as a balance sheet asset, yet is unable to completely undo potentially inappropriate income statement treatment of the IT expenditure.

This dissertation provides information about the business value of capitalized information technology. The results of this study could help standard setters (FASB, IASB), other policy makers and regulators (SEC, Fed Res Board), firm managers, and financial statement users refine standards for intangible assets, specifically information technology.

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Chapter 2

THE BUSINESS VALUE OF IT: A RATIONAL ECONOMIC ARGUMENT FOR CAPITALIZING IT EXPENDITURES

ABSTRACT

Researchers in the last decade have found large productivity improvements associated with Information Technology (IT), as well as evidence that IT contributes to the market value of the firm. However, the question still remains whether IT has a positive impact on profitability. The focus of this paper is to establish a theoretical link between productivity, profitability, and market value, resulting in a rational economic argument for capitalizing IT intangibles. Applying methods based on economic theory, this paper examines the rationally managed, profit maximizing behavior of firms in competitive markets. This analysis suggests firms will optimize production plans and precisely measure IT costs to maximize profits and stock market value.

I. INTRODUCTION

Capital investment expenditures on Information Technology (IT), such as hardware and peripherals, represented $204.9 billion in spending for firms in the United States in 2008, (U.S. Census Bureau 2010).[1] Commensurate with rapid technological change and the increasing importance of IT as a factor input, this spending number has grown steadily, up 15.04 percent from the prior year alone, despite decreasing prices (Gurbaxani et al. 2000; U.S. Census Bureau 2010). Researchers in the last two decades have found productivity improvements associated with these large expenditures, as well as evidence that IT contributes to the market value of the firm (Brynjolfsson 1993; Brynjolfsson and Yang 1999); however there lacks a clear consensus on whether IT positively affects profitability. A major reason for the lack of consensus is the absence of a theoretical framework outlining the mechanism by which IT influences profitability. The debate is further complicated by the limited data available with which to evaluate IT investment and its effect on profits. The focus of this paper is to institute a theoretical link between the components of business value and provide a rational economic argument for the necessary capitalizing of additional IT expenditures to establish a positive association with the earnings component.

The business value of IT refers to the organizational performance impacts of IT expenditures including productivity enhancements, profitability improvements, market value, and other measures of firm performance (Melville et al. 2004). Recent studies using production theory (Brynjolfsson and Hitt 1996, 2000, 2003) event studies (Dos Santos et al. 1993; Im et al. 2001; Dehning et al. 2003) and valuation models (Bharadwaj et al. 1999; Brynjolfsson et al. 2002) have overcome the "productivity paradox" by relating productivity and market value of the firm to IT capital or spending (Brynjolfsson 1993; Brynjolfsson and Yang 1999). Although these studies contribute evidence regarding the contribution of IT to the overall business value of the firm, they have yet to establish a positive significant association between IT and the earnings component of

[1] "The Information and Communication Technology Survey (ICTS), a supplement to the Annual Capital Expenditures Survey (ACES), was created in response to economic data user and policy maker concerns about the lack of available data," Information and Communication Technology, U.S. Census Bureau, May 10, 2010.

business value. Business executives are better able to allocate resources within the firm if they have a better understanding of the relationship between IT investment, productivity, profitability, and market value.

The economic theory of production has been used extensively by diverse disciplines to assess the business value of IT investments (Hitt and Brynjolfsson 1996). Using econometric techniques, value-added firm output accompanying a set of IT inputs is used to estimate marginal product, which is the increase in value-added associated with a 1 percent increase in IT expenditures. Most IT investment studies, even those adjusted for obsolescence; find higher marginal product for IT investments than for other capital investments (Dedrick et al. 2003). These excess returns are contrary to results of microeconomic theory that firms invest so that all investments pay the same risk-adjusted return at margin. Given high marginal returns, prior studies imply firms are systematically under investing in IT relative to other capital investments (Lee and Barua 1999; Brynjolfsson and Hitt 2003).

A proposed explanation for this observed under investing is that the calculations are made using IT investment measures that are plagued with measurement error (Brynjolfsson 1993; Melville et al. 2004). Since profit maximizing firms should not systematically under invest, some authors have suggested the observed anomaly results from IT investment that is observed with measurement error. This measurement error is introduced when data are taken from financial statements that have been filtered through Generally Accepted Accounting Principles (GAAP). Accounting standards can distort the quality of reported information in an attempt to improve the ability to forecast using accrual measures of periodic firm performance. Traditionally, return on assets (ROA), return on equity (ROE), and return on sales (ROS) have been used in the literature to measure profitability improvements of the firm (Dehning and Richardson 2002; Revsine et al. 2005) A limitation of these measures is that they are dependent upon accounting numbers subject to GAAP, which mandates expensing a majority of IT expenditures, leading to negatively biased financials and inaccurate performance ratios (Amir and Lev 1996). The “mismeasurement” of accounting numbers used in performance measures might explain the disconnect that exists between the components of business value, specifically the inconsistent results between IT investments and profitability (Brynjolfsson 1993). This study utilizes production theory from the business value of IT literature to show how inappropriate accounting treatment of IT expenditures can lead to the previously observed conclusions and establish a theoretical association between IT and profitability.

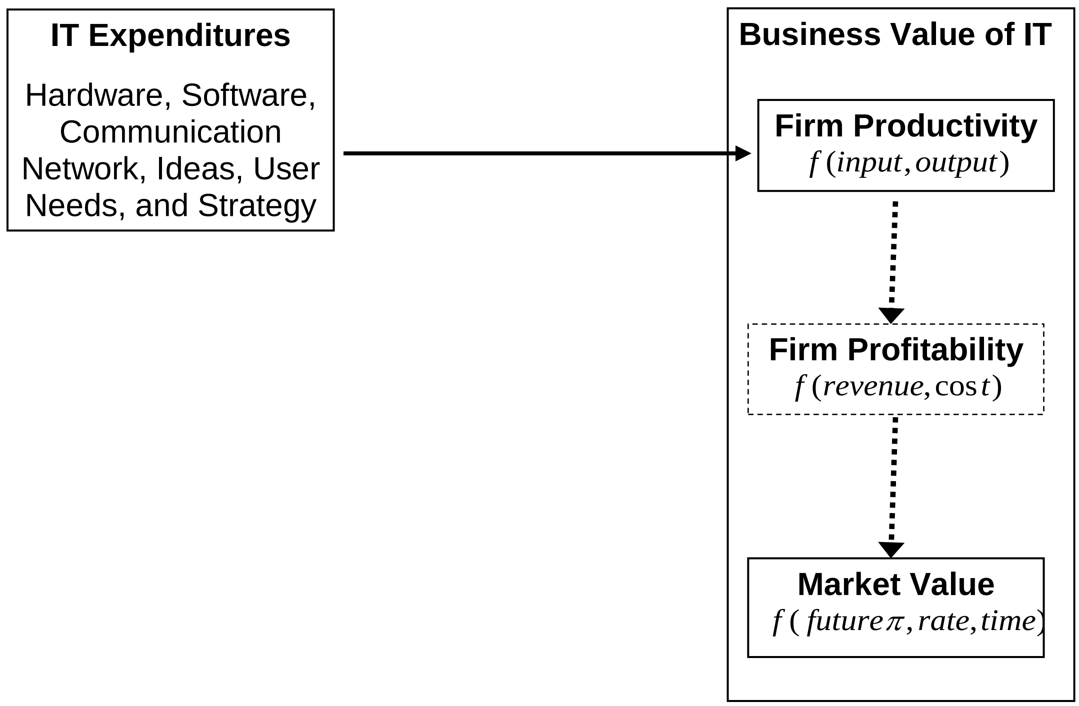
The remainder of this study is organized as follows. Section II draws from accounting, economics, and information systems literature to link theoretically the components of IT business value. Section III utilizes competitive market assumptions to apply economic theory to the business value of IT. Section IV develops a theoretically justified argument to capitalize additional IT expenditures using the mismeasurement dilemma from a balance sheet perspective. Section V concludes the discussion of IT business value, identifies limitations, and provides the contributions of this study to a diverse set of literature.

II. BACKGROUND

Our understanding of the overall relationship between IT and business value has been enriched by the diversity of ideas and findings from several academic disciplines, including information systems, economics, accounting, strategy, and operations research (Melville et al. 2004). Numerous studies have assessed the positive impact of IT investments on both productivity and market value (Brynjolfsson and Hitt 1993; Dos Santos et al. 1993; Brynjolfsson and Yang 1999; Im et al. 2001; Dehning et al. 2003). However, an appurtenant consequence of separate research streams has hampered the aggregation of ideas and findings, making it difficult for those outside of IT business value to understand what has been learned or, more importantly, which questions remain unresolved (Chan 2000). It is therefore necessary to provide a normative approach to cumulate the theoretical foundation of this work to deduce the relationship that exists between the components of business value in an attempt to establish a positive significant relationship between IT investments and profitability.

The business value of IT refers to the organizational performance impacts of IT expenditures including productivity enhancements, profitability improvements, increased market value, and other measures of firm performance (Melville et al. 2004). Prior literature has related IT to productivity and market value without establishing a relationship between IT and profitability, see Figure 1. Economics can be used to overcome the disconnect that exists between these components of business value by theoretically establishing the relationship that exist between optimized productivity plans, maximized profits, and the present value of future profit streams.

Figure 1
Business Value of IT Expenditures



Productivity

Economic theory addresses the issue of business productivity. Production economics optimizes a set of relevant inputs, such as IT expenditures, needed to produce desired firm output, such as firm performance. In addition, this theory also identifies the structural relationships and technological constraints that exist among these variables (Melville et al. 2004). A production function describes the constraints by measuring the maximum output possible from a given combination of inputs (Varian 1999). When combined with the constraints the firm faces, such as fixed quantities of some resources, resources prices, and product demand, the firm is able to determine the level of output to produce and inputs to employ to maximize profits. The present value of maximized profits represents the total stock market value a firm is expected to generate. Thus, profit maximizing firms will operate where productivity is at a maximum, and technological changes that allow the firm to improve productivity, i.e. produce more output with the same inputs or produce the same output with fewer inputs, should lead to higher profits (Dedrick et al. 2003).

The structural relationships that optimize relevant firm inputs and outputs are production functions, such as Cobb-Douglas, which utilize mathematical specifications to describe the transformation of various inputs to outputs (Varian 1999; Melville et al. 2004). It is possible to estimate the contribution of each input to total output in terms of the gross marginal benefit, which represents the rate of return on the last dollar invested. A rationally managed firm will keep investing in inputs until the output it generates adds no more value than the cost of the input (Hitt and Brynjolfsson 1996; Kudyba 2004).

Most production functions, including the Cobb-Douglas, allow some degree of substitution among inputs, including IT. The degree to which inputs can be substituted for each other in the production process will depend on the technology and is measured as the elasticity of substitution. When the technology has a diminishing rate of marginal substitution, the profit maximizing firm should choose an input combination such that the price ratio of the resources equals the marginal rate of substitution ratios and adjust input use when input prices change; such is the case with the declining price of IT (Gurbaxani et al. 2000).

Profitability

A basic assumption of firm behavior is that a firm chooses actions to maximize profits or minimize costs for the optimal level of production (Lee and Barua 1999). These actions are constrained by technology and the market. Technological constraints are concerned with the feasible combination of inputs and outputs from a specific production plan, such as the maximum level of output possible from one week of labor. Market constraints are concerned with the effects of outside agent actions on the firm, such as the price consumers are willing to pay or suppliers are willing to accept.

Firms produce n units of y outputs at price p and use m units of x inputs at price w. The first term in the expression represents revenues, how much a firm sells of various outputs times the price of each output, and the second term in the expression represents costs, how much a firm uses of each input times the price of each input. Profits are then

$$\pi = \sum_{i-1}^{n} p_i y_i - \sum_{i=1}^{m} w_i x_i$$

defined as revenues minus costs. There are many variations in the use of this term, of which two will be defined. Economic profits consider the opportunity costs of all inputs in the above equation. Whereas, accounting profits typically require the use the historical cost of only inputs that required a monetary outlay (Varian 1999).

The basic principles of profit maximization involve minimizing the cost function ($C = min\ wx$). Production plans determine the level of output and inputs necessary to

$$\max_{y,x} \quad py \geq wx$$
$$\text{s.t. } y = f(production)$$

maximize profits. The optimal choice of production plan is reached when the marginal revenue of output is equal to the marginal cost or the marginal revenue product of an input is equal to the marginal resource cost (Varian 1999). Either way, a firm that experiences productivity improvements will generally observe higher profitability, by enabling cost advantages (Dedrick et al. 2003).

Market Value

It is assumed profit maximizing firms have employed the optimal production function to maximize profits. The production process a firm utilizes often goes on for many periods. Inputs, such as capital assets, in place at time *t* contribute to outputs, such as profits, in future periods. The concept of present value can be used to value the production decision for flows of cost and revenue by introducing interest rates to define a natural price of consumption over time. The present value of firm profits represents the total stock market value a firm is expected to generate.

Shareholders generally want the firm to choose production processes that maximize the stock market value of the firm. Regardless of shareholder tastes and preferences at different times, they will always prefer an endowment with a higher present value. By maximizing profits and stock market value, the firm increases shareholder budgets and acts in the best interest of both the shareholder and firm. Thus, the profit maximization goal of the competitive firm becomes the same as the goal to maximize shareholder wealth (Varian 1999).

III. ECONOMIC THEORY APPLIED TO THE BUSINESS VALUE OF IT

The production theory approach measures the marginal benefits of IT investments. This is closely associated with the process of business value creation. If IT investments are productive, then less input is required to create more output, which should lead to improved profitability if demand for the product does not change, and ultimately increasing market value. When assuming a competitive market, the firm outcome can be technical efficiency and the pursuit of profit maximization and cost minimization by optimizing the choice of production plans. Due to its simplicity and flexibility, the Cobb-Douglas production function is commonly used in IT literature as a fundamental economic measure of IT contribution to firm value and to motivate theoretically the discussion of business value (Brynjolfsson 1993; Hitt and Brynjolfsson 1996; Barua and Lee 1997; Gurbaxani et al. 1997; Mukhopadhyay et al. 1997; Lee and Barua 1999; Gurbaxani et al. 2000; Davamanirajan et al. 2002; Kudyba 2004; Pavlou et al. 2005; Lin and Shao 2006; Wagner and Weitzel 2007).

To build a theoretical framework, assume the firm is operating in a competitive market. A perfectly competitive market has a large number of independent firms offering a homogeneous product without barriers to entry. Although this type of market is rare, the model will provide a generalization framework that can be used for evaluating the business value of IT. Most importantly, prices are exogenous variables for firms in competitive markets. Since demand is perfectly elastic at market price, e.g. price = marginal revenue ($p = MR$), the profit maximizing competitive firm will produce where price equals marginal product ($p=MR=MP$).

The following assumptions will be made to apply the Cobb-Douglas production function to the business value of IT for a perfectly competitive firm:

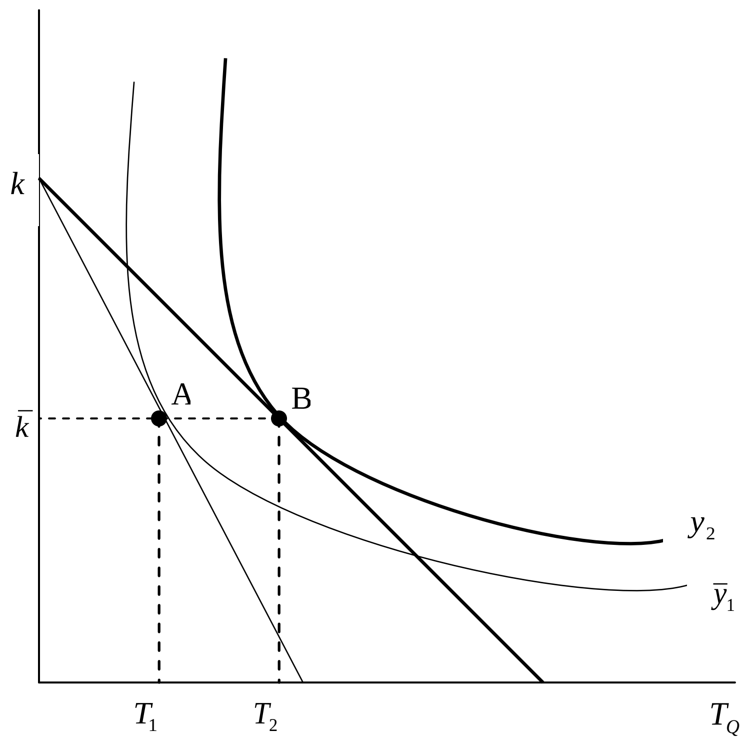
- Firms employ resources in perfectly competitive markets, e.g. price takers.
- Firms sell products in competitive markets at price = 1.

- Firms initially choose *y* (output), *K* (capital leases), *L* (labor contracts), and *T* (IT expenditures), so that profit is maximized.
- Once the initial decision is made, *K* & *L*, are fixed at *k* to evaluate the usage of *T*.
- The fixed cost of *k* is $\bar{x} = P_K K + P_L L$.
- Firms have production technology, such that $y = k^{\alpha} T^{\beta}$, where *k* is a composite measure of *K* & *L*. Also, $0 < \alpha < 1$ and $0 < \beta < 1$.

Productivity

To evaluate the contribution of IT to productivity, the optimized choice of the firm to operate at point A where they produce $\bar{y}_1$ units of output using $\bar{k}$ and T_1 as inputs is shown in Figure 2. The marginal product of T is positive, but diminishing. The firm employs T so that the marginal product of T will equal the price of T. Over time the firm is locked in to $\bar{k}$ labor contracts and capital leases while input price of *T* falls from P_1 to P_2 such that $P_2 = \gamma P_1$ ($0 < \gamma < 1$). As a result, the firm spends the same total budget dollars for an increased input quantity of *T.* Now, the firm will operate at point B and produce y_2 units of output using $\bar{k}$ and T_2 as inputs, where $\bar{k}$ is fixed.

Figure 2
Optimized Cobb-Douglas Production Function for IT Expenditures
$$y = \bar{k}^{\alpha} T^{\beta}$$



y firm output
k composite measure for quantity of capital and labor
T quantity of IT
A optimal quantity of *k* and *T* firm will operate with before price declines
B optimal quantity of *k* and *T* firm will operate with after price declines

Marginal Product of T

$\frac{\partial y}{\partial T} = \beta \bar{k}^{\alpha} T^{\beta - 1}$, marginal product

$\frac{\partial y}{\partial T} > 0$, positive

$\frac{\partial^2 y}{\partial T^2} < 0$, but diminishing marginal product of T

Firm will employ T so that $MP_T = P_T$.

When operating at point A, the firm's productivity may be measured in several ways. One measurement is to consider output per worker, where output is divided by $\bar{k}$, the composite measure for labor and capital. Another possibility is to measure productivity as a ratio of output to all resources used, where IT is commonly valued according to its capitalized value from the balance sheet. Under these two alternative productivity measures, the firm's productivity at point A is measured as $\frac{\bar{y}_1}{\bar{k}}$ and $\frac{\bar{y}_1}{\bar{k} + \phi P_1 T_1}$, respectively. At point B these measures become $\frac{y_2}{\bar{k}}$ and $\frac{y_2}{\bar{k} + \phi P_2 T_2}$ or $\frac{\gamma^{\frac{\beta}{\beta-1}} \bar{y}_1}{\bar{k} + \phi(\gamma P_1)(\gamma^{\frac{1}{\beta-1}} T_1)}$, respectively. It can be shown that if $P_2 = \gamma P_1$, then $T_2 = \gamma^{\frac{1}{\beta-1}} T_1$ and $y_2 = y_1 \gamma^{\frac{\beta}{\beta-1}}$ (see Appendix 1). Clearly, $\frac{\gamma^{\frac{\beta}{\beta-1}} \bar{y}_1}{\bar{k}}$ > $\frac{\bar{y}_1}{\bar{k}}$ if $\gamma^{\frac{\beta}{\beta-1}}$ > 1, since $0 < \gamma < 1$ and $0 < \beta < 1$. The productivity measure including the capitalized value of IT is also greater as is shown by $\frac{\gamma^{\frac{\beta}{\beta-1}} \bar{y}_1}{\bar{k} + \phi(\gamma P_1)(\gamma^{\frac{1}{\beta-1}} T_1)}$ = $\frac{\bar{y}_1}{\frac{\bar{k}}{\gamma^{\frac{\beta}{\beta-1}}} + \phi P_1 T_1}$ > $\frac{\bar{y}_1}{\bar{k} + \phi P_1 T_1}$, which is consistent with previously established productivity improvements. Both productivity measures increase when P_T decreases.

Profitability

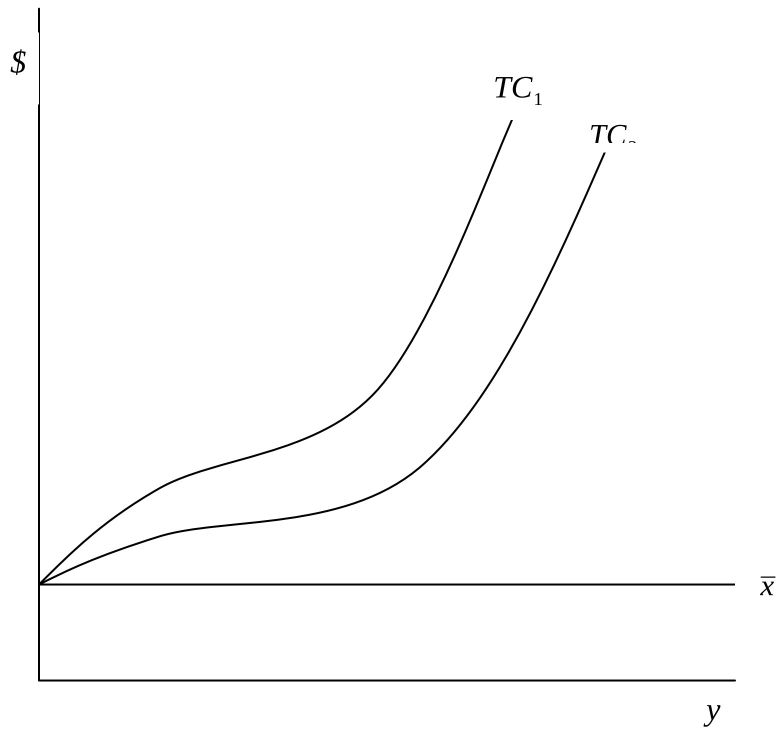
To evaluate the contribution of IT to profitability, the optimized choice of production plans must be utilized to determine the minimum level of $\bar{k}$ and T inputs and maximum level of $\bar{y}$ outputs necessary for profit maximization. Over time the firm is locked in to $\bar{k}$ labor contracts and capital leases while input price of *T* falls from P_1 to P_2 such that $P_2 = \gamma P_1$ ($0 < \gamma < 1$). As a result, the cost of $\bar{k}$ is fixed at $\bar{x}$, the firm spends the same total budget dollars for an increased input quantity of *T,* and the firm will ultimately operate at a point that produces y_2 output, where $y_2 > y_1$. The firm's profitability is measured as a function of revenues minus costs, $k^{\alpha} T^{\beta} - \bar{x} - P\,T$. It can be shown that if $P_2 = \gamma P_1$, then $\pi_2 + \bar{x} = \gamma^{\frac{\beta}{\beta-1}} (\pi_1 + \bar{x})$ (see Appendix

1). Clearly, π_2 > π_1 if $\gamma^{\frac{\beta}{\beta-1}}$ > 1, since $0 < \gamma < 1$ and $0 < \beta < 1$. Profits should increase when P_T decreases. Under this model, the firms total cost is a function of both fixed, $\bar{x}$, and variable costs, $P_T(yk^{-\alpha})^{\frac{1}{\beta}}$. When P_T falls from P_1 to P_2 , the marginal cost of the firm falls proportionally, as shown in Figure 3. The TC_2 of the firm will be slightly flatter (e.g. lower marginal cost), than TC_1 for each *y* and approach the same vertical asymptote $(y^{\max})$ based on *k*. This reiterates π_2 > π_1, since $TR_1 = TR_2$ while $TC_2 < TC_1$, which has yet to be established by prior literature.

Figure 3
Optimized Cobb-Douglas Profit Function for IT Expenditures

$$\pi = k^{\alpha} T^{\beta} - \overline{x} - P\,T$$

$$TC = \overline{x} + P_T (yk^{-\alpha})^{\frac{1}{\beta}}$$



$\overline{x}$ fixed costs
TC function of fixed and variable costs
π firm profit
P price of IT

<u>Marginal Cost of T</u>

$$\frac{\partial TC}{\partial y} = P_T \frac{1}{\beta} (yk^{-\alpha})^{\frac{1-\beta}{\beta}} k^{-\alpha}$$, marginal cost

$\frac{\partial TC}{\partial y} > 0$, positive

$\frac{\partial^2 TC}{\partial y^2} > 0$, but increasing marginal product of T

Marginal cost of firm falls proportionally.

Market Value

To evaluate the market value improvements of IT with respect to Cobb-Douglas production, the optimized choice of production plans must be utilized to determine the present value of firm profits, which represents the total stock market value of a firm. Rational investors want the firm to choose production processes that will maximize the stock market value of the firm. It is thus assumed profit maximizing firms have employed the optimal production function to maximize profits resulting in increased shareholder wealth.

The firm's market value is measured as the present value of future profit π streams where *r* is the discount parameter and *t* is time, $MV = \int_0^\infty r^t \pi_t dt$. If investors expect $\pi_t = \pi_{t+1}$, then $\int_0^\infty r^t \pi_t dt = \pi \int_0^\infty r^t dt$. Market value should be increasing in π, where $\frac{\partial MV}{\partial \pi} = \int_0^\infty r^t dt > 0$ which is consistent with previously established increases in market valuation.

IV. BALANCE SHEET PERSPECTIVE

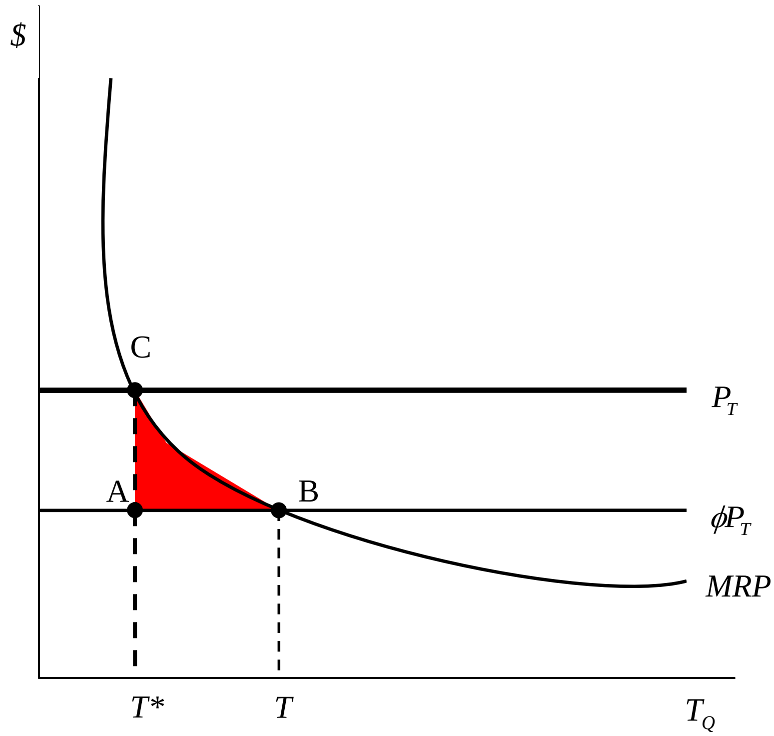
IT expenditures include both capitalized and expensed components equivalent to capital and operational dollars spent to support the IT environment. The capitalized component, which is represented on the balance sheet, includes expenditures on hardware, externally purchased software, and other capital investments associated with the IT environment (Lucas 1999). The expensed component, which is represented on the income statement, includes expenditures on development, implementation, maintenance, and other costs associated with the IT environment (Zwass 1998; O'Brien and Marakas 2007). This traditional approach for capturing accounting numbers for the financial statements, which are in turn used for calculating performance metrics, is problematic in terms of deriving the economic reality for IT related inputs, because the data necessary for a faithful representation of IT costs can be distorted by accounting reporting standards. These types of measurement errors have been held responsible for the lackluster returns from IT (Barua and Lee 1997).

IT productivity studies have not exploited the fundamental theoretical foundation of production economics, profit maximization or cost minimization, to overcome and explain the disconnect that exists between the components of IT business value (see Figure 1). IT consists of much more than just its balance sheet valuation, so issues dealing with the definition of capitalized IT or input measurement lead to disappointing results.

Profit maximizing firms should employ all resources, both tangible and intangible, so that the additional revenue from employing the resources equals the additional cost of employing the resources, *MRP* = *MRC.* This rule is an input perspective of the profit-maximizing output perspective, *MR* = *MC*, previously discussed. Since resources typically experience diminishing marginal product ($\frac{\partial^2 Q}{\partial T^2} < 0$), the resulting *MRP* curve is negatively sloped and represents the firm's demand for the resource.

In the case of Cobb-Douglas technology and competitive product markets, *MRP* is negatively sloped as illustrated in Figure 4. Since the firm is assumed to purchase IT in a competitive market, the firm's perceived supply of IT is a horizontal line at the MRC or price of IT. The current balance sheet perspective reports the value of IT as ϕP_T, in which $0 < \phi < 1$. Based on productivity studies, firms appear to be investing in *T** quantity of IT (point A), while employing the current balance sheet valuation of IT, ϕP_T. These findings have lead previous researchers to conclude firms are consistently underinvesting in IT (point A), when theory states they should increase spending by shifting to the right to employ IT at quantity *T* (point B), where *MRP* = ϕP_T.

Balance Sheet Perspective of IT
MRP = MRC = P



MRP marginal revenue product
MRC marginal resource cost
A current investment in IT before additional IT capitalization
B theoretical investment in IT before additional IT capitalization
C theoretical investment in IT after additional IT capitalization

If the firm were able to overcome distorted capitalized IT inputs by including additional IT expenditures on the balance sheet, the firm actually invests in the ideal quantity of IT, as evidenced by point C, and experiences profit maximization. By including additional IT expenditures, the firm shifts the MRC line up to move from point A to point C, without investing in additional IT. The proposed balance sheet perspective would then report the value of IT as P_T. The area of the triangle made up from the points where the firm is currently investing (point A), should be currently investing (point B), and the proposed investment (point C) represents the foregone accounting profits not captured as a result of expensing additional IT expenditures. The proposition to overcome potentially inappropriate accounting numbers by capitalizing additional IT expenditures makes it appear as if the firm has optimized their production plan and no longer under invests in IT, while both capturing lost profits and valuing the additional IT expenditures prior research has shown the market already values.

IV. CONCLUSION

There is little consensus or cumulative knowledge about the impact of IT on profitability despite the substantial effort to establish the overall business value of IT. Complex issues, such as theoretically linking business value components and quality IT investment data, are difficult problems to contend with. In addition, these issues are compounded by the mismeasurement of data utilized in metrics traditionally used to establish IT relationships, specifically profitability.

This paper synthesizes a theoretical foundation commonly used in information systems, economics, and accounting disciplines to analyze and conceptualize the relationship that should exist between the components of IT business value and then proposes the capitalization of IT intangibles based on the culmination of this knowledge.

Production theory was used to establish a theoretical association between IT expenditures and the overall business value of IT. The production based link between business value components was then used in a balance sheet context to propose the capitalization of IT intangibles to overcome a potentially inappropriate accounting treatment to establish a relationship between IT and profitability.

It is important to note that this analysis was applied to a competitive market with corresponding assumptions. The competitive environment has a strong theoretical foundation and offers potential to reconcile diverse literature within a single conceptual framework. In some markets, a positive productivity contribution does not equate to improved performance (Barua and Lee 1997) and the benefits that often pass onto other members of the supply chain are beyond this analysis and the scope of the traditional production framework.

While the investigation into the relationship between IT and profitability is far from over, there are several promising avenues for further research. As far as the production economics approach is concerned, one particularly important line of inquiry would be an empirical examination of IT intangible capitalization. It would also be extremely interesting and important to ascertain the contexts in which a greater capitalization of IT would contribute to future earnings. This study calls attention to the mismeasurement hypothesis introduced by the productivity paradox literature, specifically Brynjolfsson (1993).

Appendix 1

Business Value Reconciliation for Competitive Firms During Falling Prices

<u>*Price:*</u> $\gamma P_1 = P_2$

$$\pi_1 = \bar{k}^{\alpha} T_1^{\beta} - x - P_1 T_1 \qquad \pi_2 = \bar{k}^{\alpha} T_2^{\beta} - x - P_2 T_2$$

$$\frac{\partial \pi}{\partial T_1} = \beta \bar{k}^{\alpha} T_1^{\beta-1} - P_1 = 0 \qquad \frac{\partial \pi}{\partial T_2} = \beta \bar{k}^{\alpha} T_2^{\beta-1} - P_2 = 0$$

$$P_1 = \beta \bar{k}^{\alpha} T_1^{\beta-1} \quad (1) \qquad P_2 = \beta \bar{k}^{\alpha} T_2^{\beta-1} \quad (2)$$

$$\gamma P_1 = P_2$$

<u>*Input:*</u> substitute Equations (1) and (2) into the price function

$$\gamma \beta \bar{k}^{\alpha} T_1^{\beta-1} = \beta \bar{k}^{\alpha} T_2^{\beta-1}$$

$$\gamma T_1^{\beta-1} = T_2^{\beta-1}$$

$$\gamma^{\frac{1}{\beta-1}} T_1 = T_2 \qquad (3)$$

<u>*Output:*</u> $y = \bar{k}^{\alpha} T^{\beta}$, substitute Equation (3) into the output function

$$y_2 = \bar{k}^{\alpha} T_2^{\beta}$$

$$y_2 = \bar{k}^{\alpha} (\gamma^{\frac{1}{\beta-1}} T_1)^{\beta}$$

$$y_2 = \bar{k}^{\alpha} T_1^{\beta} \gamma^{\frac{\beta}{\beta-1}}$$

$$y_2 = \gamma^{\frac{\beta}{\beta-1}} \bar{y}_1 \qquad (4)$$

__Profitability:__ $\pi = \sum_{i-1}^{n} p_i y_i - \sum_{i=1}^{m} w_i x_i$, substitute Equations (3), (4) and (5) into the profit function

$$\pi_1 = \bar{k}^{\alpha} T_1^{\beta} - \bar{x} - P_1 T_1$$

$$\pi_1 + \bar{x} = \bar{k}^{\alpha} T_1^{\beta} - P_1 T_1 \qquad (5)$$

$$\pi_2 = \bar{k}^{\alpha} T_1^{\beta} \gamma^{\frac{\beta}{\beta-1}} - \bar{x} - \gamma P_1 \gamma^{\frac{1}{\beta-1}} T_1$$

$$\pi_2 + \bar{x} = \gamma^{\frac{\beta}{\beta-1}} (\bar{k}^{\alpha} T_1^{\beta} - P_1 T_1)$$

$$\pi_2 + \bar{x} = \gamma^{\frac{\beta}{\beta-1}} (\pi_1 + \bar{x})$$

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Chapter 3

VALUE ANALYSIS OF THE INTANGIBLE COMPONENT OF IT EXPENDITURES: IMPLICATIONS FOR THE ACCOUNTING MEASUREMENT AND REPORTING SYSTEM

ABSTRACT

The current accounting measurement and reporting system is ill-equipped to provide intangible investment information that is decision useful for stakeholders in the information economy. Potentially relevant intangible items are not reported on the balance sheet, since current standards mandate the immediate expensing of these intangible items. Presumably FASB's uncertainty with the fundamental issues of extent and timing of future benefits to the firm has led to concerns with relevance, reliability, and objectivity of capitalizing some intangibles, which results in potential long term value generating expenditures being immediately expensed on the income statement. Prior research has demonstrated extent and timing of some income statement intangibles, such as advertising and research and development, however the potential value of IT intangibles as an asset has not been investigated. The objective of this study is to propose a useful life and amortization rate estimates for a capitalization treatment of IT intangibles. A value analysis of the proposed intangible IT capitalization is investigated by associating contemporaneous equity market values and intertemporal stock returns with constructed IT book value amounts. The associations between firm contextual factors and subsequent earnings are used to ascertain more precise amortization estimates. The sample is comprised of 1633 U.S. firm year observations from *InformationWeek 500* surveys for the period 1991-1997 and industry spending information from *InformationWeek 500* surveys for the period 1998-2006. The results of this study could help standard setters (FASB, IASB, SEC, and Federal Reserve Board), firm managers, and financial statement users refine standards for intangible assets, specifically IT.

I. INTRODUCTION

Information Technology (IT) capital investments in hardware and software represented $405.2 billion of spending in the 2009 U.S. economy (Bureau of Economic Analysis 2010). This multi-billion dollar expenditure represented 35 percent[2] of the total budgeted IT dollars for 2009, leaving the remaining 65 percent of the IT budget to cover other expenditures, including an intangible component associated with IT spending. The current accounting measurement and reporting system is ill-equipped to convey decision useful information about the business value of the intangible portion of the remaining estimated $623.4 billion IT budget (Sougiannis 1994; Amir and Lev 1996). This paper initiates an investigation into the potential capitalization of the intangible component of IT by estimating the useful life and amortization rate estimates of intangible IT and then associating equity market values with contemporaneous and intertemporal firm financial data adjusted for the constructed IT amounts to indicate the market valuation of the proposed intangible IT asset treatment.

The total cost of ownership for IT investments includes both tangible and intangible components equivalent to capital and operational expenditures necessary to support the IT environment. The tangible component is typically treated as an asset and includes expenditures on hardware (2-5 years), software (10-15 years if separable), wiring (20-25 years) and other capital investments associated with the IT environment (Lucas 1999). The intangible component is typically expensed on the income statement and includes expenditures on personnel, support, and other costs for development, implementation, and maintenance of the IT environment (Zwass 1998; O'Brien and Marakas 2007). Arguably the intangible personnel costs associated with software application support or training would fail to meet the current definition of an asset, despite human capital discussions that are beyond the scope of this paper. However, many of the support costs associated with license fees, software maintenance, or upgrades could be interpreted as providing long term benefits to the overall IT investments of the firm, providing justification for an intangible asset analysis of these expenditures as a more appropriate accounting treatment.

[2] According to InformationWeek 500 surveys conducted between 1998 and 2006.

This investigation is important for a number of reasons. First, a difference exists between the current Generally Accepted Accounting Principles (GAAP) value reported in accounting financial statements (book value) and the value of the firm reflected by stock prices (market value) (Hirschey and Weygandt 1985). A potential reason for the difference between book and market values of information economy firms can be attributed to the limitation of recognition criteria employed to produce financial statements. Investors are cognizant of the current accounting deficiencies and rely primarily on other information to undo potentially inappropriate GAAP procedures (Amir and Lev 1996). This action may be hampered and costly given insufficient accounting information to enable a distinction between intangible investments and financial statement elements (Hirschey and Weygandt 1985). Furthermore, investor actions to undo accounting procedures violates the primary objective of the accounting conceptual framework, which states accounting information should be useful for decision making. Essentially, GAAP treatment of intangibles is not always consistent with investor valuation, often leading to decision irrelevant accounting information (Amir and Lev 1996).

Second, the traditional accounting model does not convey valuable information about the business value of most intangibles currently recorded on the income statement (Sougiannis 1994). Income statement intangibles, like research and development expenditures, are extremely valuable assets of the firm that lack physical substance, however they are encumbered with the uncertain extent and timing of future benefits that hinders the ability to record them on the balance sheet. Since GAAP currently mandates the expensing of most intangible expenditures in financial statements, the increasing intangible investment of information economy firms leads to inaccurate financial statements and performance ratios (Amir and Lev 1996). Ostensibly, these GAAP mandates are a result of concerns with uncertainty about the extent and timing of benefits for income statement intangible expenditures.

Third, accounting for intangibles has become one of the most widely debated issues among academics and practitioners. Traditional balance sheet intangibles, such as patents (Deng et al. 1999), goodwill (Higson 1998), and capitalized software (Aboody and Lev 1998) have been deemed valuable to investor decision making. Further studies have evaluated capitalization policies for valuable income statement intangibles, such as R&D (Sougiannis 1994; Lev and Sougiannis 1996) and advertising (Barth and Clinch 1998; Kallapur and Kwan 2004). IT intangibles have been found to be value relevant (Barth 2000), yet little empirical evidence exists to support a capitalization policy. Therefore, the goal of this paper is to initiate an investigation into the potential capitalization treatment for the intangible component of IT expenditures consistent with prior research on other income statement intangibles by: 1) relating constructed IT intangibles to future operating income to establish an amortization rate and intangible IT capital amount and 2) relating the intangible IT capital amount to current equity market values and future returns to provide evidence that the market values intangible IT expenditures as an asset.

Initially, a pooled cross sectional earnings model was utilized with a sample of public firms from *InformationWeek* surveys (1991-1997) to establish a significant positive association between intangible IT and operating income. The results of this analysis demonstrate the intangible component of IT expenditures is associated with future operating income, which is then used to establish a proposed amortization rate based upon the identified positive association between IT and earnings in future periods. The evidence from this analysis is consistent with findings from prior literature on other income statement intangibles that support potential capitalization policies.

Then, IT capital amounts were constructed using amortization estimates to perform complementary tests of market valuation for the proposed capitalization policy. Proposed book values of constructed IT amounts were associated with contemporaneous equity market values. A positive and significant association exists between the book and market values in a contemporaneous setting, consistent with information valued by investors for decision making. To determine whether the market fully recognizes the value of the contemporaneous IT capital information, constructed IT amounts were associated with future returns in an intertemporal setting. A positive and significant association exists between the constructed intangible component of IT expenditures and future returns, consistent with investor mispricing due to lack of useful and or available information for decision making. These results imply the investor is valuing the IT expenditure as a balance sheet asset, yet is unable completely to undo potentially inappropriate income statement treatment of the IT expenditure.

This investigation contributes to two streams of research, intangibles and IT. The potential capitalization of some income statement intangibles, such as R&D, software, and advertising, has been examined in prior research; however the potential capitalization of IT intangibles has not. R&D capitalization has been shown to be reliable and relevant information, which is in contrast to FASB interpretations (Lev and Sougiannis 1996). Prior studies (Hirschey 1982; Hirschey and Weygandt 1985; Bublitz and Ettredge 1989; Shevlin 1991; Sougiannis 1994; Lev and Sougiannis 1996) argue capitalization of R&D expenditures and amortization over an extended period of time would be a more appropriate accounting rule than immediate expensing. Dehning and Richardson (2002), Anderson et al. (2006), and Kobelsky et al. (2008) argue IT expenditures are similar to R&D. As a result of these findings, this study contributes to the current accounting literature for intangibles by providing additional evidence for the argument to capitalize an additional income statement intangible, specifically IT.

Early studies examining the business value of IT failed to find positive productivity or earnings improvements associated with investments in IT (Dos Santos et al. 1993). The fact that many companies were making large investments in IT despite researchers' inability to detect productivity improvements was dubbed the "productivity paradox" (Brynjolfsson 1993). Recent studies using both event studies (Dos Santos et al. 1993; Im et al. 2001; Dehning et al. 2003) and valuation studies (Bharadwaj et al. 1999; Brynjolfsson et al. 2002) have been able to overcome components of the paradox by relating market value of the firm to IT capital or spending (Brynjolfsson and Yang 1999). Although these studies provided additional evidence regarding the contribution of IT to the overall business value of the firm through productivity enhancements and market valuation, they have yet to establish an association between IT and the positive earnings component of business value, dubbed the "secondary productivity paradox." This study contributes to the current IT literature by proposing the capitalization, rather than expensing, of the intangible component of IT expenditures to overcome a potentially inappropriate accounting treatment that could establish a positive IT investment association with earnings, a necessary theoretical link between productivity and market value.

The remainder of this study is organized as follows. Section II utilizes an interdisciplinary approach through the use of accounting, economics, and information systems literature to discuss the current contribution of IT expenditures to business value. Section III draws from economic theory and prior literature to develop hypotheses for constructed IT capitalization variable associations with contemporaneous equity market values and intertemporal returns. Section IV contains a description of the research design. Section V describes the sample selection and descriptive statistics. Section VI provides results for the empirical analysis. Section VII concludes the results of the study. Section VIII provides a subsequent analysis of the findings to control for various contextual factors to provide useful information for potential IT amortization policies. The study concludes with a summary in section IX.

II. BACKGROUND AND MOTIVATION

Accounting Perspective

IT expenditures create potential intangible assets related to technology, yet are expensed as incurred. Additionally, these expenditures are often aggregated with other SG&A expenses on the income statement without any financial statement disclosures regarding the specific dollar amount of category values. Balance sheets do not reflect all long term value generating intangibles, a situation intensified by the evolution of the U.S. economy into an information-based economy, which then requires stakeholder use of external information to construct appropriate proxies for IT on the balance sheet and income statement.

Standard setters face the challenge of providing decision makers with reliable and useful financial information. Lev (2001) states that accounting policymakers, such as Financial Accounting Standards Board (FASB), the Securities and Exchange Commission (SEC), and the American Institute of Certified Public Accountants (AICPA), have dual roles both to regulate and standardize accounting functions. The regulatory role prescribes information structures and individual items that have to be included in financial reports. The standardization role attempts to establish a common language for the financial reports.

The FASB states assets must have probable future economic benefits controlled by the firm (SFAC 6). This statement refers to a reasonable expectation based on logical evidence that an investment will generate future benefit for a certain extent and amount of time. Tangible and intangible investments that meet these criteria should then be recognized as an asset in the financial statements. FASB argues empirical studies have yet to find a significant correlation between intangibles and improvements in future firm performance (Kothari et al. 2002). Thus, conservative GAAP mandates currently require immediate expensing of most intangible expenditures. Measurement and valuation difficulties with intangibles should not provide an excuse immediately to expense away relevant intangible asset information. This violation of the conceptual framework's matching principle detracts from the quality of accounting information and adversely affects the measurement of earnings. Empirical evidence supports a significant broadening of the recognition, capitalization, and amortization of intangible assets in financial reporting as necessary to communicate valuable information about managers' evaluation of the expected intangible benefits of a firm (Aboody and Lev 1998; Lev 2001). Such asset recognition provides relevant information for the prediction of future earnings, which is an important objective of financial reporting.

FASB and the International Accounting Standards Board (IASB) have now identified intangible assets as a priority topic for the International Financial Reporting Standards (IFRS) convergence initiatives set for U.S. adoption in the next six years. Many countries adopting international standards, like Australia, allow some form of asset recognition of intangibles in their own national standards, leading the international standards setters to allow the partial capitalization of R&D expenditures under IAS 38. Prior literature often attributes the reduction in value relevance of financial statements filed using U.S. GAAP to accounting treatments of intangible expenditures (Francis and Schipper 1999; Lev and Zarowin 1999; Amir and Lev 1996). Presumably this issue exists as a result of the conservative practice in the U.S. immediately to expense many value generating intangible assets. The joint boards are currently in negotiations to determine a revised conceptual framework for international standard setting, moving away from an emphasis on conservatism to an emphasis on neutrality. Moving away from conservatism provides an opportunity to investigate and modify current accounting treatments for intangible assets, specifically IT.

Information Systems Perspective

Despite the current debate of international standard setters, IT expenditures are large and the intangible asset component of this investment can no longer be ignored when estimating the overall economic contribution of IT to business value (Brynjolfsson and Hitt 2000). Lindenberg and Ross (1981) and Hirschey and Weygandt (1985) have argued the market (economic) value of the firm will reflect both tangible and intangible components that have systematic influences on future profitability. How this large investment is accounted for in the financial statements can make a difference as to whether a firm is profitable in a given year or not. The Bureau of Economic Analysis (2010) stated a $405.2 billion expenditure on hardware and software for U.S. firms in 2009. *InformationWeek* surveys between 1998-2006 state hardware and software expenditures account for an average of 35 percent of the total IT budget for firms across all industries, often resulting in the only IT assets on the balance sheet. This leaves 65 percent of the total IT budget to be accounted for. Based on the figure provided above, 65 percent would be equivalent to a $623.4 revenue reducing expense on the income statement. On years with large IT expenditures, firms could have artificially lower profitability from IT intangibles that may have generated long term value with some certainty of extent and timing of benefits. This indirect relationship between IT expenditures and firm profitability exists as a result of current accounting treatments and provides a plausible explanation for researchers' inability to establish a consistent significant positive association between IT investments and profitability improvements of business value.

The business value of IT refers to the organizational performance impacts of IT expenditures including productivity enhancements, profitability improvements, market value, and the other measures of firm performance (Melville et al. 2004). Initial research on business value of IT failed to establish positive associations between IT expenditures and measures of organizational performance (Dos Santos et al. 1993; Loveman 1994), despite companies increasing investment. This inverse relationship between firm spending and firm performance was dubbed the “productivity paradox” (Brynjolfsson 1993).

Subsequent research using production theory (Brynjolfsson and Hitt 1996, 2000, 2003), event studies (Dos Santos et al. 1993; Im et al. 2001; Dehning et al. 2003) and valuation models (Bharadwaj et al. 1999; Brynjolfsson et al. 2002) have overcome the “productivity paradox” by relating productivity enhancements and market value of the firm to IT capital or spending (Brynjolfsson and Yang 1996, 1999). Despite the ability of these former studies to contribute evidence regarding the contribution of IT to the overall business value of the firm, a consistent positive and significant relationship between IT expenditures and the profitability improvement component of business value still eludes researchers, resulting in a “secondary productivity paradox.”

Recent research on business value of IT recognizes current accounting measures as problematic. Current U.S. accounting standards for IT expenditures do not provide information to capture the impact of IT on earnings due to the treatment of the intangible portion of the expenditures (Anderson et al. 2002). To circumvent this deficiency in accounting standards, researchers have turned to forward looking market based measures, like Tobin’s q, to capture the expected intangible asset value of IT (Anderson et al. 2006). Bharadwaj et al. (1999) and Brynjolfsson et al. (2002) document positive associations between q and IT investments after controlling for numerous contextual factors. The authors argue IT expenditures include an unrecognized intangible component expected to have future probable economic benefits that generate current and future earnings, similar to research investigating other income statement intangibles, such as R&D (Nadiri and Prucha 1996: Lev and Sougiannis 1996; Anderson et al. 2006; Kobelsky et al. 2008).

Early studies on the business value of IT did not concentrate on demonstrating IT as an intangible asset, however evidence provided in recent studies suggest IT intangibles are fundamental determinants of firm value and perceived as assets. Thus, a definitive positive relationship between future earnings and IT expenditures will be difficult to establish without an adjustment for archaic accounting standards that do not address intangible assets in an information economy setting. The issue of an appropriate accounting treatment for intangibles has been debated by academics for more than three decades (Canibano et al. 2000); however this discussion has been limited with respect to IT intangibles. Therefore, this study investigates the proposed capitalization, rather than expensing, of the intangible component of IT expenditures to overcome possible mis-measurement issues introduced by the current U.S. accounting system and to establish a positive IT expenditure association with profitability that may contribute to further discussions of proposed intangible treatments for international standards.

III. HYPOTHESES DEVELOPMENT

Firms invest in IT for various reasons and can include both tangible and intangible components. Mandatory expenditures are often required to satisfy regulatory requirements, such as eXtensible Business Reporting Language (XBRL) mandates for financial reporting. Strategic expenditures are often utilized to gain sustainable competitive advantage over competition. Process or quality improvement expenditures are used to improve efficiency and reduce costs. Infrastructure expenditures are necessary expenditures for the fundamental backbone of any technology investment, such as internal wiring essential for networking functionality. Although not an exhaustive list, it begins to provide some insight into the motivation firms have to make IT investments, both for discretionary and non-discretionary management decisions. So what makes a firm continue to exceed minimum mandatory, strategic, process improvement, infrastructure, or other IT investments when prior literature would argue this is a profitability decreasing activity? How can an IT investment enhance productivity and not translate into improved profitability? Why would there be a positive market reaction to IT investments, if they truly decreased profitability implying lower future cash flows for make price determination? Basically, what do managers (productivity) and investors (market value) know that accountants do not (profitability)? Profitability is an accounting based metric using an outdated measurement system for input and output values that is compensated for by other parties in determining positive associations between productivity and market value with IT investments.

Estimation Analysis

Production theory using econometric techniques relates value added firm output to a set of IT inputs and estimates the marginal product, which is the increase in value-added associated with a 1 percent increase in IT expenditures. Most IT investment studies, even those adjusted for obsolescence, find higher marginal product than other capital investments. These excess returns are contrary to the theory that all investments pay the same risk-adjusted return at margin. Given high marginal returns, which can be measured as either operating income or abnormal stock price changes, prior studies imply firms are systematically under investing in IT as currently reported. This is contrary to the prior studies from the secondary productivity paradox that would argue IT cannot achieve high marginal returns measured as operating income and that firms are systematically over investing in IT. However, the secondary productivity paradox literature has not addressed the issue with potential mis-measurement of analysis inputs and outputs. To determine if disaggregated IT expenditures contribute to the future value of the firm, thus meeting the basic definition of an asset, the extent and timing of future positive associations is investigated to determine if further analysis of the disaggregated larger intangible portion of IT expenditures is warranted. The following hypothesis is investigated.

H1a: IT expenditures are positively associated with operating income in future periods.

A proposed solution to under investing is the attempt to measure precisely the IT intangible component of the expenditures. These expenditures are large, often several times the measured tangible component of IT (Brynjolfsson and Hitt 2000). Yet, these intangibles are unmeasured in the sense that they do not appear as a capital asset or other component of firm input (Brynjolfsson and Hitt 2000). Furthermore, the returns might appear more modest and more accurate if these intangible costs were included on the balance sheet rather than the income statement (Brynjolfsson 1993; Melville et al. 2004).

Production theory has been used in the IT literature as a measure of IT's contribution to firm business value (Brynjolfsson 1993; Hitt and Brynjolfsson 1996). This theory explains how firms chose to employ resources, including R&D and IT, to produce a desired quantity to maximize productivity or profitability. The firm's production function identifies the structural relationship that exists among these variables for a rational manager with profit maximizing goals (Melville et al. 2004). The firm's previous decision then imposes constraints, such as the current level of technology, on the feasible set of input variable combinations available to the firm in the short run. A production function incorporates these constraints when showing the maximum output possible from a given combination of inputs (Varian 1999). A problem arises with this method when mis-measured inputs, such as expensed intangible IT capital, are entered into the function for production enhancements as a positive input from an economic view and then entered into the function for desired profit maximization as a negative input from an accounting view. Thus, researcher interpretations of profitability are vulnerable to potential accounting errors in accounting input amounts for production functions within production theory. This might explain why researchers are able to find productivity enhancements using economic amounts, not subject to accounting standards, yet continue to be perplexed by the lack of a positive association with profitability dependent upon accounting amounts. Therefore, it is the contention of this study that firms are rationally managed and optimally invest in IT, but that IT is misrepresented in financial reports, ultimately leading to the expensing of a value generating expenditure.

Evidence from production theory provides insight into the properties of the remaining IT intangibles. They have a long-term effect on firm performance and can legitimately be part of the productive assets of the firm. Such unmeasured intangibles make estimated IT growth and productivity contributions appear larger than theory would predict. As seen in the literature to date, calculations that ignore these potentially large intangibles likely over or under value estimates, which can ultimately lead to an insignificant association with profitability (Brynjolfsson and Hitt 2000, 2003). The weak link between IT contributions and output appear to be the result of performance measures poorly accounted for by the accounting numbers (Brynjolfsson 1993). Thus, the prediction of the estimation analysis is that the intangible component of IT expenditures has a positive long-term effect on profitability, which will lead to the potential capitalization of a value-added income statement intangible by providing the extent and timing of once uncertain benefits.

H1b: Constructed intangible component of IT expenditures are positively associated with operating income in future periods.

Contemporaneous Analysis

Investors are interested in making informed decisions by having access to accounting information that aids in the assessment of firm value created by production and investment activities rather than having to un-do inappropriate accounting treatments to assess firm value (Barth et al. 2001). Inputs-to-equity valuation theory states an objective of financial statements is to provide data that serve as inputs to equity market valuation (Barth 1994; Samia and Zhou 2004; Wang and Zhang 2009). In other words, accountants provide information used by stakeholders to value the equity of a firm. Value studies attempt to operationalize key dimensions of FASB's theory to assess the value of accounting information (Aboody and Lev 1998). A significant predicted relationship with equity market values implies the reported accounting amount in the financial statements is valuable information for decision makers, providing evidence that the primary objective of the FASB conceptual framework is being met to some extent (Barth et al. 2001; Barth and Clinch 1998).

FASB's definition of an asset[3] states an investment must provide probable future economic benefit obtained or controlled by the firm as a result of past economic events. An asset may be intangible and not transferable, yet still used by the firm to produce or distribute goods and services. Uncertainty – a discriminating characteristic – of intangible assets better distinguishes them from tangible assets than the lack of physical substance. While uncertainty may provide some justification for applying specific accounting measurement rules, they do not provide any justification for denying investors fundamental information about intangibles. It makes sense to recognize intangibles as assets when the uncertainty about benefits is resolved (Lev 2001). Recall accounts receivable and prepaids have no physical substance and are associated with some amount of future uncertainty, yet are reported with tangible assets on the balance sheet (Spiceland et al. 2007).

The expectation of the intangible component of IT expenditures to be associated with earnings beyond the current period is consistent with the basic definition of an asset and implies

[3] FASB 1985b, para. 25-26, & 173

the potential capitalization of the intangible component of the IT expenditures as shown in hypothesis 1b. Excluding IT intangibles from the balance sheet detracts from the quality of accounting information and adversely affects the measurement of earnings as evidenced by the inability of prior research to confirm consistently a positive significant relationship between IT expenditures and profitability. A significant predicted relationship between capitalized IT intangible expenditures and contemporaneous equity market values indicates investors value the constructed IT capitalization information (Barth et al. 2001; Barth 2000).

> H2: Constructed capitalized IT intangible expenditures are positively associated with contemporaneous equity market values.

Intertemporal Analysis

Asymmetric information exists when firm managers have superior information to the market during a transaction. This condition is a result of market participants not having access to valuable information needed for decision making and can cause the markets to become inefficient in a contemporaneous setting (Frankel and Li 2004; Bernard and Thomas 1990).

IT expenditure information is considered proprietary by most firms and not a required disclosure by accounting standards, this results in IT investments being unobserved components of the balance sheet and income statement. Financial statement users must consider outside sources of information to “undo” inappropriate expensing treatment of IT intangibles. If the users are unable to acquire adequate information fully to undo the treatment, the equity market values are mispriced in the contemporaneous setting, resulting in a significant association between the accounting amount and subsequent equity market values (Kobelsky et al. 2008; Lev and Sougiannis 1996).

The usefulness of accounting numbers lies in the ability to summarize equity market values, which assumes the market reflects all valuable public information. It is reasonably clear that the market does not have perfect information about IT expenditures fully to construct intangible IT assets, which may additionally imply market inefficiency in the contemporaneous setting. If the market is unable fully to recognize the proposed asset treatment for IT intangibles, a significant predicted relationship between capitalized IT intangible expenditures and future equity market values will exist.

H3: Constructed capitalized IT intangible expenditures are positively associated with subsequent stock returns

IV. RESEARCH DESIGN

This paper disaggregates IT expenditures from financial statement accounting amounts to test hypotheses H1a-H3. Specifically, this paper considers intangibles related to technology, constructed using IT budget information reported by firms included in the *InformationWeek 500* between 1991-2006. Since IT accounting amounts are unobservable, the tangible and intangible IT spending ratios are based on industry estimates reported in *InformationWeek 500* surveys between 1998-2006. (The year 1999 was dropped from the analysis due to confounding issues with Y2K expenditures.) The IT spending amounts are constructed using total dollar amounts from early surveys (1991-1997) combined with percent of IT budgets devoted to different IT spending categories by industry in the latter surveys (1998-2006).

The importance of other intangible assets is evidenced by their inclusion in International Standards, not recognized in the U.S. presumably as a result of uncertainty. Proxies for other intangible assets will be based on research and development and advertising expenditures. Although expensed in financial statements, these expenditures often represent long-term investment in intangible assets (Barth et al. 2001) as evidenced by prior research (Hirschey and Weygandt 1985; Bublitz and Ettredge 1989; Sougiannis 1994; Lev and Sougiannis 1996). Proxies for assets derived from accounting amounts are assumed to provide reliable information, as a result of GAAP’s use of reliability to generate accounting information through the conceptual framework. It is implicitly assumed that reliable summarized sources of information about firm assets is most likely not ascertained outside of the financial statements (Barth, et al. 2001).

Estimation Analysis

Canibano et al. (2000) discuss how both tangible and intangible assets determine profitability. As a result of the fundamental relationship that exists between assets owned by the firm and the earnings generated by these assets, earnings can be defined as a function of both tangible and intangible assets. An earnings model can be utilized to evaluate the extent and timing of the positive significant associations between assets and earnings. In accordance with the fundamental principles of accrual accounting, this model can be used to establish a finite useful life for IT to capitalize appropriately and allocate IT expenditures to periods in which the asset is expected to contribute to revenue generating activities. The future benefit, or useful life, provided by the asset will be determined by the duration of the statistically significant IT coefficient. If the models are subject to correlated omitted variables, the coefficient estimates may be overstated.

Following the work of Lev and Sougiannis (1996), Graham and Frankenberger (2000), Rajgopal et al. (2003), and Muhanna and Stoel (2010) the estimation for IT capital is derived using the following earnings model to test the extent and timing of IT benefits and evaluate IT spending in its entirety against other presumed income statement intangible assets. This model will begin with current year values (*t* = 0) on both the dependent and independent sides of the equation to determine current year associations between balance sheet and income statement intangibles with operating income. Then the model will be re-estimated several times rolling the dependent variable, operating income, forward one year at a time (*t* + *k),* holding the independent variables constant in time *t* to determine how many future periods the independent variables, especially the IT experimental independent variable, maintain a positive and significant association with operating income, indicating the extent and timing of future benefits associated with each of the proposed assets.

$$OI_{i,t+k} = \propto_0 + \propto_1 IT_{i,t} + \propto_2 ADJ\_TA_{i,t} + \propto_3 RD_{i,t} + \propto_4 AD_{i,t} + e_{i,t} \qquad (1)$$

All variables are scaled by sales to reduce heteroscedasticity. OI is operating income before depreciation for current and subsequent periods. All independent variables are reported for firm *i* at time *t. IT* is the total IT expenditure for the year, *ADJ_TA* is total assets adjusted for the tangible portion of IT spending now reflected in the overall IT expenditure variable, *RD* is research and development, and *AD* is advertising.

IT expenditures include an uncapitalized intangible component expected to have future probable economic benefits that generate current and future earnings. To further evaluate IT, the variable is decomposed into a tangible and intangible component to evaluate the intangible portion of the expenditure. The intangible IT amount is constructed from industry spending estimates reported in *InformationWeek 500* surveys between 1998-2006. The year 1999 was dropped from the analysis due to confounding issues surrounding Y2K expenditures. Firms provided the percent of IT budgets spent on hardware for each year. The hardware percentages were averaged and then reported as an estimate for the tangible portion of the reported IT budgets information provided in *InformationWeek 500* surveys for years 1991-1997. The hardware amount was then added back to the total asset amount where it would initially appear as a capitalized asset on the balance sheet. The remaining intangible component is isolated as the experimental independent variable of interest in the current model of interest estimated similarly to Equation (1) with aggregated IT and adjusted total assets.

$$OI_{i,t+k} = \propto_0 + \propto_1 ITI_{i,t} + \propto_2 TA_{i,t} + \propto_3 RD_{i,t} + \propto_4 AD_{i,t} + e_{i,t} \qquad (2)$$

where all variables are scaled by current sales to reduce heteroscedasticity. OI is operating income before depreciation for current and subsequent periods. All independent variables are reported for firm *i* at time *t. ITI* is the intangible component of the total IT expenditure for the year, *TA* is total assets, which includes the tangible component of the total IT expenditure originally reported on the balance sheet, *RD* is research and development, and *AD* is advertising.

Contemporaneous Analysis

The usefulness of accounting amounts lies in their ability to summarize equity market values. A contemporaneous association between IT intangibles and equity market values indicates the extent to which IT capitalization is consistent with the information used by the market. If the accounting amount significantly increases the R^2 of the estimating equation to explain market equity values, then the information is relevant to decision makers and measured with some reliability (Barth 2000).

To evaluate the role of accounting information contained in the financial statements, equity market values are regressed on the primary summary measures for the balance sheet and income statement (Ohlson 1995). To examine the value of accounting information contained in the financial statements, the general form of the following benchmark model is evaluated to ensure the dataset is consistent with prior literature:

$$MVE_{i,t} = \propto_0 + \propto_1 BVE_{i,t} + \propto_2 IBEI_{i,t} + e_{i,t} \qquad (3)$$

where all variables are scaled by lagged book value of equity to reduce heteroscedasticity. *MVE* is the market value of equity, *BVE* is book value of equity, *IBEI* is income before extraordinary items for firm *i* at time *t.*

Equation (2) of the estimation analysis above provides evidence that the intangible component of the IT expenditure exhibits asset behavior similar to other intangible assets, e.g. R&D, from prior literature. Based on these findings, statistically reliable amortization estimates can be computed using the extent of the significant intangible IT variable in explaining subsequent earnings. Due to a data constraint, the IT variables will be constructed assuming a three-year obsolescence rather than estimating the obsolescence from variable statistical significance, resulting in a more conservative approach. The net book value of the capitalized intangible IT amount is constructed using two consecutive years of the IT intangible variable. Using standard straight-line amortization procedures, the net book value of the IT intangible asset is two-thirds of the current period constructed intangible component of IT expenditures plus one-third of the prior period intangible IT expenditure. The accumulated earnings adjustment for IT intangible amortization requires three consecutive years of the IT intangible variable. Using standard straight-line amortization procedures, two-thirds current period constructed intangible component of IT expenditures is added back to earnings less one-third of the two prior periods constructed intangible component of IT expenditures.

To examine the value of a proposed IT amortization policy, the benchmark model is augmented to include the constructed IT variables:

$$MVE_{i,t} = \propto_0 + \propto_1 BVE_{i,t} + \propto_2 ADJ\_IBEI_{i,t} + \propto_3 BVITI_{i,t} + e_{i,t} \qquad (4)$$

where all variables are scaled by lagged book value of equity to reduce heteroscedasticity. *MVE* is the market value of equity, *BVE* is book value of equity, *ADJ_IBEI* is income before extraordinary items adjusted for the annual capitalization of intangible IT, and *BVITI* is the book value of the constructed intangible component of IT expenditures for firm *i* at time *t.*

An asymmetric treatment exists for firms with negative earnings and book-values (Collins et al. 1999), especially when dealing with discretionary expenditures. Failing to distinguish the two groups in regression analysis reduces the ability of the independent variables to explain equity market values. A dummy variable, *LOSS*, was set to 1 for negative earnings firms and a dummy variable, *NEGBK*, was set to 1 for negative book value of equity firms. These dummy variables were used to create interaction terms, (LOSS*IBEI) and (NEGBK*BVE), in both contemporaneous models above to isolate and interpret loss firms, rather than reduce the sample size.

Intertemporal Analysis

To evaluate the extent of market reaction to a proposed IT amortization policy in an intertemporal setting, constructed intangible IT variables and fundamentals are associated with subsequent returns (Fama and French 1992) in the following cross-sectional model. To examine the conformity of the dataset to prior literature, the general form of the fundamental subsequent returns model is evaluated, where stock returns are regressed on lagged values of firm accounting fundamental variables:

$$Ret_{i,t+j} = \propto_{0,j} + \propto_{1,j} \beta_{i,t} + \propto_{2,j} Size_{i,t} + \propto_{3,j} BM_{i,t} + \propto_{4,j} Lev_{i,t} + \propto_{5,j} EPM_{i,t} + \propto_{6,j} EPMDum_{i,t} + e_{i,t+j} \quad (5)$$

where *Ret* is the monthly stock return starting with the seventh month after year end, β is the standard risk calculation from the CAPM model based on the previous 60 monthly returns, log *MVE* is a firm size calculation, log *BM* is book-to-market adjusted for deferred taxes, log *Lev* is total assets to book value of equity, *EPM* is the earnings price ration, and *EPMDum* is a dummy variable set to 1 if the firm has negative earnings for firm *i* in time *t*.

The accounting fundamental amounts are for year-end time *t,* at which time six months are allowed to lapse for disclosure of publically available financial statement information, followed by 12 monthly stock returns (*t + j).* For each of the seven years of available IT spending data, 12 subsequent months of cross-sectional returns regressions are run, a total of 84 regression computations. Mean coefficient estimates for the 84 months will be reported.

Equation (4) from the contemporaneous analysis above provides evidence that the proposed intangible IT capitalization policy is valued by the market. However, it is uncertain whether the market is able fully to recognize the information in the proposed policy. To examine whether the market is able fully to recognize the value of the proposed IT amortization policy in a contemporaneous setting, the constructed IT variable is included in the fundamental subsequent returns model following the contention of Lev and Sougiannis' (1996) evaluation of investor reaction to R&D expenditures estimated similarly to Equation (5) with net book value of IT capital.

$$Ret_{i,t+j} = \propto_{0,j} + \propto_{1,j} \beta_{i,t} + \propto_{2,j} Size_{i,t} + \propto_{3,j} BM_{i,t} + \propto_{4,j} Lev_{i,t} + \propto_{5,j} EPM_{i,t} + \propto_{6,j} EPMDum_{i,t} + \propto_{7,j} BVITIM_{i,t} + e_{i,t+j} \quad (6)$$

where *Ret* is the monthly stock return seven months after year end, *β* is the standard risk calculation from the CAPM model based on the previous 60 monthly returns, log *BM* is book-to-market adjusted for deferred taxes, log *Lev* is total assets to book value of equity, *EPM* is the earnings price ration, *EPMDum* is a dummy variable set to 1 if the firm has negative earnings, and *BVITIM* is the net book value of intangible IT over MVE for firm *i* in time *t*.

V. DESCRIPTION OF SAMPLE

Sample Selection

The sample consists of 546 public firms from the 1992-1997 *InformationWeek 500* annual budget surveys. Since firms are not required to report information about IT spending in financial reports to stakeholders, this source provides large scale reporting of IT spending for public firms over an extended period of time (Bharadwaj et al. 1999; Bharadwaj 2000; Santhanam and Hartono 2003; Anderson et al. 2006; Kobelsky et al. 2008). There is subjectivity in the measurement of IT budgets, as well as survey responses, which likely induces measurement error in the reported IT spending amounts. The estimates of coefficients on IT spending are likely to be biased downward, making the tests conservative (Anderson et al. 2003). Financial information was obtained from Compustat, while returns information was obtained from CRSP. Rather than exclude estimation model observations for missing advertising and R&D spending amounts, these values were set to zero (Anderson et al. 2006).

Table 1 Panel A reports an initial public sample of 1697 firm year observations. Due to insufficient annual financial information on Compustat, the initial estimation model is tested using 1633 firm year (546 firms) observations, which represent 96 percent of the initial *InformationWeek 500* sample. Two consecutive years of IT spending information is necessary to calculate a proposed net IT capitalization variable. This data restriction results in a reduction of the sample to 915 firm year (400 firms) observations available for contemporaneous and intertemporal analysis.

Three consecutive years of IT spending information is necessary to calculate a proposed IT amortization variable. This data restriction results in a final reduction of the sample to 466 firm year (212 firms) observations for contemporaneous analysis. Table 1 Panel B also provides additional information about firm year observations used in the initial estimation model. Although 76 percent (52 percent) of the observations (firms) had more than 3 years of available IT spending information, only 27 percent of the observations have consecutive years of IT spending data for IT variable construction in subsequent analysis.

Table 1 Panel C reports the industry composition of the sample for both the estimation model and contemporaneous analysis. Manufacturing represents the largest industry in the estimation (contemporaneous) sample, 30 percent (32 percent). Using a single digit industry code, 2 – food processing, manufacturing, chemicals, and manufacturing (2) represents over half of the sample. Real estate, hospitality, entertainment, health services, and biotechnology drop out of the sample for the contemporaneous analysis.

Table 2 provides variable definitions for the estimation, contemporaneous, and intertemporal models. A description, any necessary variable construction calculation, and item location for replication are included. To avoid losing sample observations due to outliers, the sample data is winsorized 1 percent at each end of the distribution after variable construction. This process transforms the extreme values to a specified percentile, rather than trimming the extreme values from the sample.

As previously stated, IT spending information is not publicly available to stakeholders. The *InformationWeek 500* reporting has served as an accepted proxy in prior literature (Bharadwaj et al. 1999; Bharadwaj 2000; Santhanam and Hartono 2003; Anderson et al. 2006; Kobelsky et al. 2008). This value serves as an aggregate amount for total IT spending, but does not distinguish between the tangible and intangible expenditure. To estimate tangible and intangible IT allocation rates for the reported spending amounts, 1998-2006 *InformationWeek 500* surveys were used to determine the average hardware and application spending for firms by industry. The estimate calculations excluded survey information from 1999, which was confounded by the Y2K anomaly. This event led firms to an unusual one year increase in IT personnel spending to resolve a technology coding issue allowing information systems to rollover from 1999 to 2000. Table 3 provides a list of the calculated allocations by industry. The weighted average tangible (intangible) allocation rate for the sample IT spending is .175 (.825). The retail and health services industries have tangible IT spending allocation rates closer to 20 percent, while the food processing industry is closer to 11 percent.

Descriptive Statistics

Table 4, panels A and B, provides descriptive statistics for the estimation and contemporaneous models. Both unadjusted and scaled variables are provided for analysis. Panel A reports the mean operating income, OI, is $1419.32 million for the sample period. The minimum OI for the sample is -$1048 million, which indicates loss firm year observations are a part of the sample. Sales were used as a scaling variable for the estimation sample to control for size. OI is 17.4 percent of sales, while constructed tangible IT (intangible IT) is 2.2 percent (1.8) percent of sales. The minimum values for IT in the unadjusted (scaled) results have a value of 0 (.002), which implies the values were indiscernible before scaling. Panel B reveals the mean book value of equity, BVE, is $3964.37 million. The mean market value of equity, MVE, is $11,920.44 million, indicating the market's assessment of the firm is higher than the reported book value. Once again, negative amounts are reported in the minimum values for the earning variables, as well as the book value amounts for the contemporaneous analysis, further indicating loss firms are a part of the sample. BVE is used as a scaling variable for the contemporaneous sample to control for size.

VI. EMPIRICAL FINDINGS

Estimation Analysis

Table 6 presents regression summary statistics for the estimation equation (Equations (1) and (2)), which relates earnings to assets using a pooled cross section. In Panel A, both current and subsequent earnings are regressed on both assets adjusted for IT hardware and the IT expenditure variable. R&D and advertising are included from prior literature as proxies for additional unobserved intangible assets. In Panel B, the same regression is run with unadjusted total assets and the intangible component of the IT expenditure variable. Once again, R&D and advertising are included as control variables. The sample size decreases over time as a result of data limitations on consecutive years available for analysis.

In Panel A, the coefficient of the experimental variable (IT) has the expected sign and remains significant for more than 5 subsequent periods after the initial expenditure. In addition, the coefficient and significance increase over time, perhaps as a result of one or more combined hypotheses from the productivity paradox[4] in which Brynjolfsson (1993) states time lags between the time of the IT expenditure and subsequent benefit received result from the extensive learning and adjustments necessary fully to capture IT value. These results imply IT expenditures are positively associated with earnings into future periods, similar to other assets (ADJ_TA) and proposed intangible assets from prior literature (RD). Also, the coefficients for RD are nearly twenty times larger than the coefficients of ADJ-TA, which is also consistent with prior literature investigating the asset behavior of R&D (Sougiannis 1994; Lev and Sougiannis 1996). Notably, the coefficients of IT are even larger than RD, which Barth et al. (2001), Aboody et al. (1999), and Barth (1994) would interpret as evidence that the IT accounting amount have more value than the RD amount. Contrary to the expected behavior of advertising from prior literature, this variable is both positive and significant in subsequent periods (Bublitz and Ettredge 1989). This could be a result of extending intangible analysis to an IT intensive sample of firms, in which the advertising discretionary expenditure actually behaves like an asset rather than an expense.

In Panel B the variables reflect the constructed IT intangible measures. The results are consistent with Panel A for an analysis of the intangible portion of the IT expenditure. The coefficients of the control variables are not statistically different between the two panels; however the coefficients for the experimental variable are statistically higher for the intangible portion of the IT expenditure. These results provide evidence of the IT intangible benefit beyond the current period and can be used to propose a capitalization policy for intangible IT expenses currently reported on the income statement. The useful life of the proposed asset could be based upon the significance of the IT variable in future periods, such as 6 years (t+5). However, due to data constraints an IT obsolescence of three years will be used as a more conservative approach to a

[4]Brynjolfsson (1993) identified four possible explanations for the productivity paradox: mismeasurement, redistribution, time lags and mismanagement.

proposed amortization policy that will be utilized to construct both a capitalized intangible IT asset and an amortized IT expense for further analysis.

Contemporaneous Analysis

Table 7 contains the summary regression statistics for the role of the balance sheet and income statement in explaining contemporaneous equity market values for sample firms. A benchmark model for BVE and IBEI is investigated before isolating the experimental variable (BVITI) to confirm previous findings on the relationship between equity market values and accounting financial statement information (Barth et al. 2001). An F-test analysis of the overall model for each iteration of the model yields a significance less than 0.01 alpha. The findings provide empirical support for market valuation of a proposed IT capitalization policy.

In the initial benchmark model, both the balance sheet (BVE) and income statement (IBEI) have a positive and significant association with equity market values (MVE). This implies accounting amounts have a role in explaining values in the equity market. However, the R^2 value (.1083) for the benchmark is unusually low. As per the sample description above, loss firms in the sample could be responsible for the low R^2 value. It has been shown losses do not appear to be correlated with contemporaneous equity market values, as investors in a loss situation do not appear to evaluate based on reported earnings leading to a weak association between earnings and equity market values (Hayn 1995). Thus, an interaction term for loss firms as well as negative book value firms was introduced into the model to control for the loss firms without dropping them and further reducing the sample size. In the second column both interaction terms are significant, implying both negative book value and loss firms should be interpreted in a different way. The coefficients for the BVE and IBEI in the second column are positive and significant for positive book value and gain firms. The association between earnings (IBEI) and equity market values (MVE) is nearly four times greater for these firms, with an R^2 of .4354. IT studies using similar models yielded R^2 values between .35 & .37, implying the results of the model in this paper are consistent with other IT studies (Krishnan and Sriram 2001; Anderson et al. 2001). Studies using other equity market value techniques for analysis of IT or R&D have R^2 values between 0.44 and

0.66, providing further evidence that the results for this model are consistent with current literature (Lev and Sougiannis 1996; Aboody and Lev 1998; Wang and Alam 2007).

Column 3 of Table 7 introduces the experimental variable (BVITI) for the constructed intangible IT asset.[5] After analysis of the benchmark model, an insignificant BVE and low R^2 is not surprising before adding the necessary interaction terms. Column 5 includes an interaction term for negative book value, loss firms, and IT intangible expenditures of loss firms. Because a component of IT is discretionary, loss firms often make different (or less) IT expenditure decisions. Therefore, an interpretation of the experimental variable in column 5 is only valid for gain firms without a negative book value. The R^2 for these firms increases to .4503 when the intangible IT asset is included in the model. The coefficient for the (BVITI) net book value of intangible IT asset (4.996) is over three times larger than the (BVE) proxy for balance sheet variables (1.452), further attesting to the importance placed on the value of the constructed intangible IT investment by the market as an asset (Barth et al. 2001).

An overall evaluation of Table 7 contributes to a value analysis of the experimental variable. According to prior literature, the market values IT intangibles as an asset if it has a positive and significant association with equity market values (MVE), which is does in columns 3-5. Additionally, the market is perceived to value IT intangibles as an asset if the R^2 of the valuation model statistically increases when the experimental variable is added to the benchmark model, which can be observed between column 2 (.4354) and 5 (.4503). These results imply the market impounds intangible IT information as constructed as an asset. However, it is reasonably clear that the market does not have perfect information about IT expenditures fully to construct intangible IT assets, which may additionally imply market inefficiency in the contemporaneous setting.

Intertemporal Analysis

Table 8 provides evidence of an incomplete contemporaneous adjustment for intangible IT asset information. Following the work of Lev and Sougiannis (1996), a benchmark model where future stock returns are regressed on Fama and French (1992) fundamentals is reported

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[5] For further explanation, see Table 2 for variable calculation.

with t-statistics in parentheses. Consistent with prior literature, the size variable is positive and significant for all three models. However, the book-to-market ratio is insignificant and not statistically different from zero, whereas risk is positive and significant. This may be a result of some firms having a negative book value of equity. Loss firms were controlled for with the EPM dummy variable.

When the intangible IT asset is introduced into the benchmark regression model, the coefficient is positive and statistically significant at one percent (0.0019) and improves the R^2 from 0.077 in the benchmark model to 0.088 in the final model. An incremental r-square test reveals the difference in these models is statistically significant at the 15 percent level (F-value 2.0625, p-value 0.15). These results indicate market mispricing, a market under reaction to intangible IT information, exists for the intangible component of IT expenditures in sample firms. It is also possible the positive significant findings in the intertemporal analysis are a result of market compensation for an additional risk factor associated with IT spending.

VII. CONCLUSION

The following conclusions can be drawn from the evidence presented above: 1) The proposed intangible IT capitalization treatment yields statistically reliable amortization rate estimates that can be used to construct useful intangible IT asset variables. 2) The intangible IT adjusted accounting amounts were found to be significantly associated with contemporaneous and intertemporal equity market values, indicating an intangible IT capitalization treatment is implicitly being done by investors. However, it appears the constructed IT asset treatment is not fully reflected in the contemporaneous setting, since the constructed intangible IT book value was positive and significant in the intertemporal setting. These results suggest either an under reaction to intangible IT information or an additional risk factor for IT spending. These findings should not suggest capitalization of other income statement intangibles, since IT expenditures include both a discretionary component similar to R&D and advertising, as well as a non-discretionary component similar to other operational property, plant, and equipment. This unique characteristic sets it apart from traditional income statement intangibles, but further emphasizes the need to evaluate IT expenditures as assets through its non-discretionary component.

The results of the analysis in this paper make a significant contribution to the mounting evidence regarding the need to re-evaluate income statement intangibles. By showing the asset behavior of another income statement intangible during a time period the U.S. was transitioning into an information economy, it was posited and empirically demonstrated that IT expenditures contribute to firm earnings for up to five or more future periods and that investors value IT as value generating expenditures in both contemporaneous and intertemporal settings.

The results of this study lend themselves to further analysis, as the extent and timing of IT benefits to firm earnings and equity market values is likely dependent upon firm and industry contextual factors (Dehning et al. 2003). Using the equity market value approach to examine IT expenditures, one particularly important line of inquiry would be to empirically assess the proposed IT intangible capitalization in an international setting to assist international standards setters with the current controversy surrounding an appropriate treatment for intangibles under IAS 38 – Intangible Asset Recognition, Measurement, and Disclosure. It would also be interesting and important to ascertain the impact of proposed accounting treatments for IT expenditures on the performance incentives of IT managers currently based on metrics comprised of accounting numbers. This study calls attention to the mismeasurement hypothesis introduced by the productivity paradox literature, specifically Brynjolfsson (1993).

VIII. SUBSEQUENT ANALYSIS

Measurement and valuation difficulties concerning intangibles should not provide an excuse immediately to expense relevant intangible spending information. This violation of the matching principle distorts subsequent period financial statements by under-valuing assets on the balance sheet and over-reporting expenses leading to lower earnings on the income statement. This inappropriate over expensing of IT intangibles is evidenced by the inability of prior research to confirm a positive significant relationship between IT expenditures and profitability. Excluding certain intangibles from the balance sheet detracts from the quality of accounting information, also adversely affecting the measurement of earnings. Lev (2001) states a significant broadening of the recognition, capitalization, and amortization of intangible assets in financial reporting is necessary to overcome the gap that exists between market and book value amounts.

The primary objective of financial accounting is to provide useful information for decision making purposes. Intangible expenditures that affect the current financial position or future performance of a firm should be reported to contribute to the usefulness of financial statements. However, accounting for intangibles is a complex area of accounting research and often results in the conclusion that accountants fail to recognize appropriately valuable intangible assets on the balance sheet. Contrary to the primary objective of the accounting conceptual framework, investors are cognizant of the current accounting measurement and reporting system deficiencies for intangibles and rely primarily on other information to undo some of the obviously inappropriate GAAP treatment. Regardless of investor need for useful IT information, little empirical evidence exists to support the capitalization of IT expenditures in financial statements, much less provide information as to how to amortize appropriately firm IT values.

The prior contemporaneous and intertemporal analysis of this study indicates IT expenditures provide long-term benefits to the firm, while the market values the potential capitalization of the proposed IT asset. However, due to the volatile nature of IT spending, the duration of the future benefits of IT expenditures cannot provide appropriate amortization interpretations without considering both industry and technology contextual factors. To establish statistically reliable amortization rate estimates for a proposed amortization policy of the constructed IT asset variable, appropriate industry and technology amortization parameters must be computed to estimate better the duration of the statistically significant regression coefficients from the initial estimation model.

Earlier studies utilized industry designation (Dos Santos et al. 1993; Im et al. 2001; Chatterjee et al. 2002; Dehning et al. 2003; Oh et al. 2006) as an industry contextual factor and strategic IT role (Dehning et al. 2003; Oh et al. 2006) as a technology contextual factor. To remain consistent with prior research, these characteristics were utilized as proxies for contextual factors to analyze potential amortization policies.

Industry

Individual industry designations have the potential to influence the duration of coefficient significance in the original estimation model. Differences in IT expenditures between industries exist for various reasons, such as competitive needs, technology complexity, or government regulation. These differences lead to varying amounts of expenditures between firms seeking IT investments for short term gain or long term strategies. Thus, it should be expected that individual SIC codes would yield differing results for the useful life of constructed IT assets between industries.

To develop an estimation model for testing the extent and timing of IT benefits by industry, the initial earnings Equation (1) will be utilized:

$$OI_{i,t+k} = \propto_0 + \propto_1 IT_{i,t} + \propto_2 ADJ\_TA_{i,t} + \propto_3 RD_{i,t} + \propto_4 AD_{i,t} + e_{i,t}$$

where all variables are scaled by sales to reduce heteroscedasticity. *OI* is operating income before depreciation for current and subsequent periods. All independent variables are reported for firm *i* at time *t. IT* is the total IT expenditure for the year, *ADJ_TA* is total assets adjusted for the tangible portion of IT spending now reflected in the overall IT expenditure variable, *RD* is research and development, and *AD* is advertising. Additionally a 2-digit industry dummy variable was created to restrict statistical analysis by specific industry.

Using the original sample, Table 9 evaluates the impact of an industry contextual factor on the proposed amortization policy for the aggregate IT expenditure variable. As discussed in the estimation results of the empirical findings section above, IT (intangible) contributes to more than 6 years of future earnings. This would imply a straight-line (based on annual statistical significance) or reverse accelerated (based on increasing coefficient over time) amortization policy would be appropriate for aggregate (intangible) IT spending. As discussed in the sample description, manufacturing makes up half of the sample, with Transportation-Communication-Utilities (TCU) and Finance-Insurance (FI) making up a combined 25 percent of the final sample.

The first five columns of the table provide results for industries that have significant IT coefficients. The remaining industries yield insignificant coefficient associations with future earnings (OI), indicating the industry designation does matter when evaluating the long term contribution of IT to firm performance. An F-test analysis of the overall model for each iteration of the results in this table (36 total) yielded a significance less than 0.01 alpha, except for the retail industry analysis, which yielded a significance less than 0.05 alpha. Interestingly, manufacturing (retail) has negative statistically significant coefficients less than one (two) for years 0-6 (2-5) that do not appear to increase over time. Based on economic history surrounding the time frame of this sample, it is not surprising to find this relationship with retail. Dot.coms, or on-line retailing, were making substantial investments in start-up IT initiatives without concern for earnings. The focus of these firms was on maximizing initial public offerings and subsequent share price. Negative earnings were a common practice for these firms, as well as over investment in technology. There was an assumption that simply adding .com to your name would make you successful, the dot.com bust has shown otherwise. As for manufacturing, the negative coefficient may be driven by the high costs of technology and robotics incurred by early adopters of the 1990's. Also, these expenditures allowed for product customization expected by consumers, no longer allowing for the profit maximization of mass production. Both of these practices could lead to an overinvestment in IT.

The remaining industries, TCU, FI, and Service in column 2, 4, and 5 have positive and significant coefficients for the association between IT and subsequent earnings, but none are significant for the first two years. The TCU industry is significant and declining in years 2-5. These findings may be a result of the fiber optic and digital cell phone costs incurred by firms in the 1990's. Meaning in the initial years (0-1) the firms were incurring infrastructure costs that were recouped in years 2-5, but were constantly requiring updates and suffering obsolescence resulting in the declining coefficient. The FI industry is significant and declining in years 4-5. These findings may be a result of regulatory requirements for rigorous and robust IT initiatives for security and private networks. These types of initiatives must be mature before deployed, meaning the contribution of these investments would not be observed for several years. The service industry has a coefficient similar to the TCU industry, but only significant in year 5. The transition from labor to IT in the 1990's may account for the insignificant coefficients in the earlier years.

To propose an acceptable amortization policy, the useful life of the proposed asset could be based upon the significance of the IT variable in future periods as reported in Table 9. The most appropriate amortization policy for firms in the TCU, FI, and Service industries would include reporting the IT expenditure as an asset on the balance sheet and then expensing the asset using a reverse acceleration amortization procedure. Accordingly, the remaining industries would immediately expense IT expenditures.

Expenditure Type

Strategic IT roles have the potential to influence the duration of coefficient significance in the original estimation model. Automate IT investments replace traditional labor processes with technology. Informate IT investments provide internal users with information for management decision making. Transform IT investments radically redesign firms or processes. Differences in IT expenditures between strategic roles lead to IT investments for short term gain or long term strategies. Thus, it should be expected that strategic IT roles would yield differing results for the useful life of constructed IT assets.

To develop an estimation model for testing the extent and timing of IT benefits by expenditure type, the initial earnings Equation (1) will be utilized:

$$OI_{i,t+k} = \propto_0 + \propto_1 IT_{i,t} + \propto_2 ADJ\_TA_{i,t} + \propto_3 RD_{i,t} + \propto_4 AD_{i,t} + e_{i,t}$$

where all variables are scaled by sales to reduce heteroscedasticity. *OI* is operating income before depreciation for current and subsequent periods. All independent variables are reported for firm *i* at time *t. IT* is the total IT expenditure for the year, *ADJ_TA* is total assets adjusted for the tangible portion of IT spending now reflected in the overall IT expenditure variable, *RD* is research and development, and *AD* is advertising. To restrict statistical analysis by specific expenditure type, an AIT dummy variable was created. The expenditure type (automate, informate, or transform) was determined for each firm using the industry IT strategic role classification utilized by Dehning et al. (2003).

Using the original sample, Table 10 evaluates the impact of an IT expenditure type contextual factor on the proposed amortization policy for the aggregate IT expenditure variable. As discussed in the estimation results of the empirical findings section above, IT (intangible) contributes to more than 6 years of future earnings. This would imply a straight-line (based on annual statistical significance) or reverse accelerated (based on increasing coefficient over time) amortization policy would be appropriate for aggregate (intangible) IT spending.

The columns of the table provide IT coefficient results for expenditure type. An F-test analysis of the overall model for each iteration of the results in this table (18 total) yielded a significance less than 0.01 alpha. The first column of Table 10 provides results for automate technology investments, which is positive and significant for years 2-5. This is not surprising given this type of technology often substitutes automation for unskilled labor or changes simple processes to eliminate inefficiencies. Along with these automations, users typically receive training that improves learning and ability over time, similar to the lag hypotheses introduced by Brynjolfsson (1993). The second column of Table 10 reports insignificant coefficients for informate technology investments. These types of investments tend to over inform users, leading to inefficient uses of technology investments. The final column of Table 10 reports positive and significant coefficients for transform technology expenditures in years 0-6, without increasing over time. It appears firms are able to capture quickly the IT intelligence injected into re-engineered processes.

To propose an acceptable amortization policy, the useful life of the proposed asset could be based upon the significance of the IT variable in future periods as reported in Table 10. The most appropriate amortization policy for automate and transform IT expenditures would include reporting the IT expenditure as an asset on the balance sheet and then expensing the asset using a straight line amortization procedure. Accordingly, informate IT expenditures would be immediately expensed.

The results for the subsequent analysis contend a more appropriate accounting treatment for the constructed IT asset includes an amortization policy based on both industry and technology contextual factors rather than the current GAAP treatment immediately to expense. These findings use appropriate industry and technology contextual factors to provide statistically useful amortization rate estimates for capitalized IT typical of other forms of operational asset expenditures. In addition to these research findings, IT amortization policies should be guided by management experience and industry norms to estimate productive useful life. The amortization rates may then be revised as the actual benefits of the IT intangibles materialize. This recognition policy to amortize supports the matching principle by periodically matching the IT expenditure with the corresponding benefits and leads to reported earnings that more meaningfully reflect firm performance. Thus, augmenting standards to include intangibles in the recognition, capitalization, and amortization rules for assets is a necessary enhancement for current accounting practices (Lev 2001).

IX. SUMMARY

The widely debated issue of intangible assets has spilled over into an international setting, through talks between FASB and IASB standard setters. Providing better decision making information about the intangible expenditures of firms is a high priority for convergence initiatives, leading standards away from the conservative practices of GAAP. In anticipation of a converged standard on intangibles, this study initiates an investigation into the potential capitalization treatment of an IT intangible by evaluating the predictive ability of IT expenditures with respect to subsequent earnings to propose a useful life and amortization rate estimates. The findings suggest that IT intangible capitalization yields statistically reliable and economically valued information and contextual factors provide additional information for constructing more appropriate amortization estimates for IT spending. The results of this study provide empirical support for the inclusion of contextual based intangible IT assets on the balance sheet despite GAAP mandates.

Assessing contextual factors provides statistically significant information about the extent and timing of the future benefits of IT expenditures, overcoming the primary GAAP argument against capitalization. In accordance with standard setting to be decision useful, intangible IT expenditures can be better evaluated by decision makers when more appropriately placed in the financial statements. The results of this study would imply firms making automate or transform IT investments or firms in the TCU, retail, and FI industries are more likely to investment in technology with long term contributions to firm performance, otherwise known as IT assets.

The results of this study have implications for managers, standard setters, and researchers. For example, the equity market value assessment of IT value shows the importance of assessing IT expenditures as potential assets because the market already is. Further, the results of this study provide evidence to support the contention that income statement intangibles can contribute to the future value of the firm, leading to a potential capitalization treatment for IT, like R&D studies in the last two decades.

There are limitations to this study. The constructed IT amounts were based on IT budget data obtained through *InformationWeek* surveys of IT departments anticipated annual spending before year-end. Efforts to construct accurately tangible and intangible IT amounts were made using additional budget information from subsequent time periods; however final expenditure amounts may have deviated from the budget responses. It is expected that spending did not significantly deviate from the total standard budget number, however the breakdown of spending may have.

Further investigation of IT contexts, in addition to context interaction analysis, provides a significant opportunity for future research. This study evaluated context on an independent basis, without regard for the interaction on the expenditure simultaneously meeting multiple contextual criteria. Extending prior research to examine context impact on amortization rate estimates would allow for an analysis of a more appropriate capitalization treatment for IT expenditures. Further insight into a more appropriate treatment for intangibles would be valuable, both to researchers and standard setters who contribute to a discussion on international standards convergence issues.

TABLE 1
Sample Description
Public Firm Observations from 1991-1997 *InformationWeek 500* Surveys

Panel A - Sample Composition of IT Variable

	# Firm Year Observations	% Available Sample
Public Firms observations from 1991-1997 *InformationWeek 500* surveys	1697	100%
Less: Insufficient Compustat data	64	4%
Estimation model (546 firms)	1633	96%
Less: missing 2 consecutive years of IT expenditure information[1]	718	42%
Available for computation of net IT capitalization (400 firms)	915	54%
Less: missing 3 consecutive years of IT expenditure information[2]	449	26%
Available for computation of IT amortization (212 firms)	466	27%

[1]A minimum of 2 consecutive years of IT information is necessary to calculate the proposed net capitalization of IT used in contemporaneous and intertemporal analysis.

[2]A minimum of 3 consecutive years of IT information is necessary to calculate the proposed amortization of IT used in contemporaneous analysis.

Panel B - Sample Composition of Firm Year Observations

# IT Expenditure Observations by Firm	Observation Frequency	% Available Sample	Firm Frequency	% Available Sample	Cumulative % Available Sample
1	118	7%	118	22%	22%
2	283	17%	142	26%	48%
3	309	19%	104	19%	67%
4	261	16%	66	12%	79%
5	259	16%	52	10%	88%
6	202	12%	35	6%	95%
7	201	12%	29	5%	100%
Total Sample	1633	100%	546	100%	

Panel C - Industry Composition

Sic Code	Industry Description	# Observations Estimation Model	% of sample	# Observations Contemporaneous Analysis	% of sample
10-14	Mineral	30	1.84%	13	2.79%
15-17	Construction	17	1.04%	3	0.64%
20	Food Processing	61	3.74%	11	2.36%
21-27	Manufacturing	165	10.10%	41	8.80%
28	Chemicals	133	8.14%	43	9.23%
29-39	Manufacturing	488	29.88%	151	32.40%
40-47	Transportation	86	5.27%	28	6.01%
48	Communication	59	3.61%	11	2.36%
49	Utilities	108	6.61%	37	7.94%
50-51	Wholesale	69	4.23%	22	4.72%
52-59	Retail	98	6.00%	21	4.51%
60-62	Finance	163	9.98%	45	9.66%
63-64	Insurance	51	3.12%	13	2.79%
65-67	Real Estate	4	0.24%	0	0.00%
70	Hospitality	6	0.37%	0	0.00%
72-73	Consulting	69	4.23%	23	4.94%
75-76	Automotive	6	0.37%	4	0.86%
78-79	Entertainment	7	0.43%	0	0.00%
80	Health Services	6	0.37%	0	0.00%
87	Biotechnology	7	0.43%	0	0.00%
	Total Observations	1633	100%	466	100%

TABLE 2

Variable Definitions[2]

Panel A: Estimation Model[1]

Variable Name	Description
OI_SLS	Operating income before depreciation scaled by sales (Compustat items 13 & 12)
IT_SLS	IT expenditure scaled by sales (*InformationWeek 500* surveys 1991-1997 and Compustat item 12)
ITI_SLS	Intangible IT expenditures scaled by sales (estimated from industry and firm specific *InformationWeek 500* IT expenditure surveys) (Computstat item 12)
TA_SLS	Total assets scaled by sales (Compustat items 6 & 12)
ADJ_TA_SLS	Total assets adjusted for annual tangible IT expenditure scaled by sales (estimated from industry & firm specific *InformationWeek 500* surveys) (Compustat items 6 & 12)
RD_SLS	Research and development scaled by sales (Compustat items 46 & 12)
AD_SLS	Advertising scaled by sales (Compustat items 45 & 12)

Panel B: Contemporaneous Model[1]

Variable Name	Description
MVE_BVE	Market value of equity scaled by lagged BVE (price times shares outstanding) (Compustat items 25, 199, & 60)
BVE_BVE	Book value of equity scaled by lagged BVE (Compustat item 60)
NEGBK	Dummy variable set to 1 if the firms BVE is negative
IBEI_BVE	Income before extraordinary items (Compustat item 18)
ADJ_IBEI_BVE	Income before extraordinary items adjusted for annual capitalization of ITI scaled by lagged BVE (earnings plus current ITI expenditure less one-third current period ITI expenditure less one-third one subsequent period ITI expenditure less one-third two subsequent period ITI expenditure) (Compustat item 18)
LOSS	Dummy variable set to 1 if the firms IBEI is negative
BVITI_BVE	Net book value of intangible ITI expenditures scaled by lagged BVE (two-thirds current period ITI expenditures plus one-third one subsequent period ITI expenditures)

Panel C: Intertemporal Model[1,3]

Variable Name	Description
RET	Monthly stock return starting with 7th month after year-end
β	Risk based on 60 monthly stock returns prior to RET
SIZE	Log of market value of equity (price times shares outstanding) (Compustat items 25 & 199)
BM	Log of book value of equity plus deferred taxes to market value of equity (Compustat items 25, 50, 60 & 199)
LEV	Log of book value of assets to book value of equity (Compustat items 6 & 60)
EPM	Positive IBEI plus deferred taxes less preferred dividends to market value of equity (Compustat items 18, 19, 25, 50 & 199)
EPMDum	Dummy variable set to 1 if the firms earnings are negative
BVITIM	Book value of intangible ITI expenditures to market value of equity (Compustat items 25 & 199)

[1]All Variables winsorized p(.02)
[2]All Compustat and *InformationWeek 500* items are based on annual information
[3]All CRSP items are based on monthly information

TABLE 3
Descriptive Statistics
(All variable defined in Table 2)

Panel A – Estimation Model
Unadjusted (Raw)
Variables **N = 1633**

Variable	Mean	Median	Std. Dev.	Min	Max
OI	1419.32	686.24	2322.38	-1048.00	29055.00
IT	200.10	76.84	435.53	0.00	5105.01
ITI	165.61	63.92	362.90	0.00	4339.26
TA	15338.68	5591.30	30865.26	232.52	303989.00
ADJ_TA	15304.19	5561.37	30828.98	229.40	303861.80
RD	196.03	0.00	644.60	0.00	8900.00
AD	111.84	0.00	390.94	0.00	4100.00

Scaled Variables[1] **N = 1633**

Variable	Mean	Median	Std. Dev.	Min	Max
OI_SLS	0.174	0.148	0.108	0.001	0.476
IT_SLS	0.022	0.018	0.017	0.002	0.078
ITI_SLS	0.018	0.015	0.014	0.002	0.063
TA_SLS	2.185	1.012	3.061	0.244	13.093
ADJ_TA_SLS	2.182	1.008	3.060	0.242	13.092
RD_SLS	0.018	0.000	0.031	0.000	0.153
AD_SLS	0.009	0.000	0.021	0.000	0.103

[1]All variables scaled by sales and winsorized p(.02)

Panel B - Contemporaneous Analysis
Unadjusted (Raw) Variables **N = 466**

Variable	**Mean**	**Median**	**Std. Dev.**	**Min**	**Max**
MVE	11920.44	5790.31	17437.32	74.92	1033341.30
BVE	3964.37	2542.55	4167.11	-1181.71	24001.13
IBEI	610.40	319.40	1046.58	-7987.00	6698.00
ADJ_IBEI	618.07	325.36	1068.25	-7987.00	7248.00
BVITI	236.40	100.87	471.88	6.01	4026.17

Scaled Variables[2] **N = 466**

Variable	**Mean**	**Median**	**Std. Dev.**	**Min**	**Max**
MVE_BVE	2.927	2.499	2.248	-1.535	16.782
BE_BVE	1.071	1.063	0.290	0.060	2.549
IBEI_BVE	0.143	0.157	0.182	-0.605	0.890
ADJ_IBEI_BVE	0.143	0.160	0.159	-0.446	0.460
BVITI_BVE	0.059	0.046	0.059	-0.070	0.341

[2]All variables scaled by lagged book value of equity and winsorized p(.02)

TABLE 4
Pairwise Pearson (Upper Right Triangle) and Spearman (Lower Left Triangle) Correlations
(All variable defined in Table 2)

Panel A - Estimation Model[1,2]

Variable	OI_SLS	IT_SLS	ITI_SLS	TA_SLS	ADJ_TA_ SLS	RD_SLS	AD_SLS
OI_SLS	1.0000	0.2830 (0.0000)	0.2867 (0.0000)	0.5494 (0.0000)	0.5493 (0.0000)	0.0125 (0.6145)	-0.0268 (0.2787)
IT_SLS	0.3212 (0.0000)	1.0000	0.9995 (0.0000)	0.3452 (0.0000)	0.3443 (0.0000)	0.1606 (0.0000)	-0.0552 (0.0258)
ITI_SLS	0.3260 (0.0000)	0.9995 (0.0000)	1.0000	0.3387 (0.0000)	0.3379 (0.0000)	0.1620 (0.0000)	-0.0493 (0.0462)
TA_SLS	0.7217 (0.0000)	0.3580 (0.0000)	0.3602 (0.0000)	1.0000	1.0000 (0.0000)	-0.2155 (0.0000)	-0.1498 (0.0000)
ADJ_TA_SLS	0.7216 (0.0000)	0.3544 (0.0000)	0.3566 (0.0000)	1.0000 (0.0000)	1.0000	-0.2157 (0.0000)	-0.1498 (0.0000)
RD_SLS	-0.0654 (0.0082)	0.1445 (0.0000)	0.1462 (0.0000)	-0.1843 (0.0000)	-0.1851 (0.0000)	1.0000	0.1614 (0.0000)
AD_SLS	-0.0439 (0.0759)	0.0231 (0.3501)	0.0257 (0.2986)	-0.1746 (0.0000)	-0.1745 (0.0000)	0.1850 (0.0000)	1.0000

[1]P-values reported in parentheses
[2]All variables scaled by sales and winsorized p(.02)

Panel B - Contemporaneous Analysis[1,2]

Variable	MVE_BVE	BVE_BVE	IBEI_BVE	ADJ_IBEI_BVE	BVITI_BVE
MVE_BVE	1.0000	0.2650 (0.0000)	0.3185 (0.0000)	0.3566 (0.0000)	0.3702 (0.0000)
BE_BVE	0.2724 (0.0000)	1.0000	0.6291 (0.0000)	0.5698 (0.0000)	0.0997 (0.0314)
IBEI_BVE	0.5899 (0.0000)	0.5621 (0.0000)	1.0000	0.9633 (0.0000)	-0.0096 (0.8363)
ADJ_IBEI_BVE	0.5640 (0.0000)	0.5798 (0.0000)	0.9756 (0.0000)	1.0000	0.0108 (0.8168)
BVITI_BVE	0.2220 (0.0000)	0.0814 (0.0790)	0.1338 (0.0038)	0.1364 (0.0032)	1.0000

[1]P-values reported in parentheses
[2]All variables scaled by book value of equity and winsorized p(.02)

TABLE 5

Intangible Spending Allocations[1]

Sic Code	Industry Description	N	Tangible Allocation Rate	Difference from mean	Intangible Allocation Rate	Difference from mean
10-14	Mineral	30	0.160	-0.015	0.840	0.015
15-17	Construction	17	0.181	0.006	0.819	-0.006
20	Food Processing	61	0.108	-0.067	0.892	0.067
21-27	Manufacturing	165	0.180	0.005	0.820	-0.005
28	Chemicals	133	0.159	-0.016	0.841	0.016
29-39	Manufacturing	488	0.180	0.005	0.820	-0.005
40-47	Transportation	86	0.189	0.014	0.811	-0.014
48	Communication	59	0.150	-0.025	0.850	0.025
49	Utilities	108	0.161	-0.014	0.839	0.014
50-51	Wholesale	69	0.163	-0.012	0.837	0.012
52-59	Retail	98	0.218	0.043	0.782	-0.043
60-62	Finance	163	0.187	0.012	0.813	-0.012
63-64	Insurance	51	0.160	-0.015	0.840	0.015
65-67	Real Estate	4	0.174	-0.001	0.826	0.001
70	Hospitality	6	0.173	-0.002	0.827	0.002
72-73	Consulting	69	0.175	0.000	0.825	0.000
75-76	Automotive	6	0.178	0.003	0.822	-0.003
78-79	Entertainment	7	0.194	0.019	0.806	-0.019
80	Health Services	6	0.200	0.025	0.800	-0.025
87	Biotechnology	7	0.160	-0.015	0.840	0.015
	Total	1633	0.175		0.825	

[1]Used average hardware spending from 1998-2006 *InformationWeek 500* surveys (less 1999) to estimate tangible allocation rates

TABLE 6
Estimation Results[1]
(All variable defined in Table 2)

Panel A: Total IT Expenditure

$$(OI)_{i,t+k} = \alpha_0 + \alpha_1 (IT)_{i,t} + \alpha_2 (ADJ\_TA)_{i,t} + \alpha_3 (RD)_{i,t} + \alpha_4 (AD)_{i,t}$$

Experimental Variable	**t**	**t+1**	**t+2**	**t+3**	**t+4**	**t+5**
IT	0.499 (1.66)*	0.577 (2.00)**	0.714 (2.53)**	0.842 (2.98)***	0.864 (3.10)***	0.803 (2.81)***
Control Variables						
ADJ_TA	0.020 (13.82)***	0.021 (15.10)***	0.021 (14.63)***	0.021 (13.03)***	0.021 (12.84)***	0.022 (13.47)***
RD	0.390 (2.24)**	0.417 (2.31)**	0.433 (2.23)**	0.466 (2.44)**	0.442 (2.35)**	0.485 (2.42)**
AD	0.217 (1.61)	0.275 (1.96)*	0.311 (2.23)**	0.347 (2.44)**	0.446 (2.99)***	0.526 (3.36)***
Constant	0.111 (17.21)***	0.109 (17.15)***	0.109 (16.89)***	0.108 (16.27)***	0.106 (15.98)***	0.102 (15.08)***
R Sq	0.326	0.361	0.369	0.354	0.340	0.336
F Value	68.00	77.76	73.13	58.06	59.89	69.07
N	1633	1593	1540	1469	1393	1328
Firms	546	540	527	506	477	456

Panel B: Intangible IT Expenditure

$$(OI)_{i,t+k} = \alpha_0 + \alpha_1 (ITI)_{i,t} + \alpha_2 (TA)_{i,t} + \alpha_3 (RD)_{i,t} + \alpha_4 (AD)_{i,t}$$

Experimental Variable	**t**	**t+1**	**t+2**	**t+3**	**t+4**	**t+5**
ITI	0.668	0.758	0.924	1.077	1.103	1.020
	(1.81)*	(2.14)**	(2.66)***	(3.11)***	(3.22)***	(2.91)***
Control Variables						
TA	0.019	0.021	0.021	0.021	0.021	0.022
	(13.77)***	(15.05)***	(14.59)***	(13.00)***	(12.82)***	(13.48)***
RD	0.384	0.420	0.427	0.459	0.436	0.480
	(2.20)**	(2.27)**	(2.19)**	(2.41)**	(2.32)**	(2.39)**
AD	0.216	0.274	0.309	0.344	0.443	0.523
	(1.60)	(1.95)*	(2.22)**	(2.41)**	(2.96)***	(3.34)***
Constant	0.111	0.108	0.108	0.107	0.105	0.101
	(17.05)***	(17.00)***	(16.76)***	(16.16)***	(15.87)***	(14.98)***
R Sq	0.327	0.362	0.370	0.356	0.342	0.338
F Value	68.09	77.83	73.23	58.25	60.20	69.34
N	1633	1593	1540	1469	1393	1328
Firms	546	540	527	506	477	456

*, **, *** Significant at 10%, 5%, and 1% levels, respectively

[1]All variables scaled by sales

TABLE 7
Contemporaneous Results[1]
(All variable defined in Table 2)

$$MVE_{it} = \alpha_0 + \alpha_1 BVE_{it} + \alpha_2 IBEI_{it} + e_{it}$$

$$MVE_{it} = \alpha_0 + \alpha_1 BVE_{it} + \alpha_2 ADJ\_IBEI_{it} + \alpha_3 BVITI_{it} + e_{it}$$

Experimental Variable					
BVITI			13.857	7.462	4.996
			(9.01)***	(4.85)***	(3.27)***
Control Variables					
BVE	0.830	0.850	0.320	0.984	1.452
	(1.89)*	(2.35)**	(0.84)	(2.65)***	(3.99)***
NEGBK*BVE		0.899		0.215	0.586
		(1.81)**		(0.44)	(1.25)
IBEI	3.104	11.126			
	(4.45)***	(13.69)***			
LOSS*IBEI		-17.844			
		(-13.72)***			
ADJ_IBEI			4.656	9.458	8.640
			(6.76)***	(10.94)***	(10.28)***
LOSS*ADJ_IBEI				-15.733	-12.965
				(-9.42)***	(-7.80)***
LOSS*BVITI					28.712
					(6.32)***
Constant	1.596	0.166	1.105	-0.131	-0.342
	(3.75)***	(0.47)	(2.97)***	(-0.36)	(-0.99)
R Sq	0.1083	0.4354	0.2625	0.4024	0.4503
N	466	466	466	466	466
F-value	28.13	88.88	54.82	61.96	62.67

*, **, *** Significant at 10%, 5%, and 1%, respectively
[1]All variables scaled by lagged BVE

TABLE 8

Intertemporal Results

(All variables defined in Table 2)

$$R_{i,t+j} = \alpha_{0,j} + \alpha_{1,j} Risk_{i,t} + \alpha_{2,j} Size_{i,t} + \alpha_{3,j} B/M_{i,t} + \alpha_{4,j} Lev_{i,t} + \alpha_{5,j} EPM_{i,t} + \alpha_{6,j} EPMDum_{i,t} + \alpha_{7,j} BVITI_{i,t} + e_{i,t+j}$$

Regression	Intercept	Risk	Size	B/M	Leverage	EPM	EPM Dummy	Book Value of IT	R^2 (F-value)
Without IT	0.0003	0.0049	0.0009	0.0006	0.0008	-0.0049	0.0013		0.077
	(0.06)	(1.92)**	(1.58)*	(0.63)	(0.80)	(-0.37)	(0.71)		(2.09)**
With IT	0.0052	0.0044	0.0011	-0.0001	-0.0001	-0.0082	0.0022	0.0018	0.086
	(0.87)	(1.75)**	(2.03)***	(-0.14)	(-0.10)	(-0.60)	(1.22)	(3.26)***	(2.07)**
With IT	0.0058	0.0043	0.0011	-0.0001	-0.0001	-0.0088	0.0026	0.0019	0.088
Intangible	(0.96)	(1.72)**	(1.97)***	(-0.14)	(-0.12)	(-0.63)	(1.37)	(3.38)***	(2.07)**

*, **, *** Significant at 10%, 5%, and 1%, respectively

TABLE 9

Industry Amortization Rates[1]

(All variables defined in Table 2)

Mean coefficient estimates of IT variable from estimation model restricted by industry

Industry (2 digit SIC)	**Manufacturing** (20-39)	**Transportation Communication & Utilities** (40-49)	**Retail** (52-59)	**Finance & Insurance** (60-69)	**Service** (70-87)	**Other** (<20, 50, 51)
t	-0.5503	0.4949	-1.3152	0.3024	-0.1623	0.0534
	(-2.34)**	(0.53)	(-1.46)	(0.67)	(-0.20)	(0.06)
t+1	-0.5079	1.0238	-1.0248	0.2192	-0.0396	-0.1708
	(-2.21)**	(1.47)	(-1.14)	(0.48)	(-0.05)	(-0.20)
t+2	-0.4811	1.7939	-1.5673	0.3024	0.2207	-1.1130
	(-2.06)**	(2.12)***	(1.80)*	(0.67)	(0.25)	(-1.28)
t+3	-0.5028	1.7518	-1.5875	0.5481	0.5913	-1.1199
	(-2.05)**	(3.06)***	(1.82)*	(1.12)	(0.73)	(-1.00)
t+4	-0.5366	1.5221	-1.8461	0.9102	1.1432	-1.1617
	(-2.12)**	(2.13)**	(-2.37)**	(1.92)*	(1.45)	(-0.97)
t+5	-0.6101	1.1214	-1.4347	0.7916	1.7122	-1.743
	(-2.12)**	(1.50)	(-1.67)*	(1.67)*	(1.92)*	(-1.39)
# Firm Years	847	253	98	218	101	116

T-statistics reported in parentheses, *, **, *** significant at 10%, 5%, and 1%, respectively

[1]All variables scaled by sales and winsorized p(.02)

TABLE 10

Industry Amortization Rates[1]

(All variables defined in Table 2)

Mean coefficient estimates of IT variable from estimation model restricted by type of IT expenditure

Expenditure Type	Automate	Informate	Transformate
t	0.6282	-0.2431	1.1194
	(1.24)	(-0.92)	(2.11)**
t+1	0.7039	-0.0553	1.1023
	(1.46)	(-0.22)	(2.12)**
t+2	1.0319	0.1046	1.0736
	(2.19)**	(0.40)	(1.99)**
t+3	1.0819	0.3188	1.066
	(2.12)**	(1.22)	(2.01)**
t+4	1.0535	0.2259	1.4493
	(2.11)**	-0.84	(2.46)**
t+5	0.9763	0.0507	1.8130
	(1.94)*	(0.17)	(3.02)***
No. of Firm Years	473	927	233

T-statistics reported in parentheses, *, **, *** significant at 10%, 5%, and 1%, respectively

[1]All variables scaled by sales and winsorized p(.02)

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Chapter 4

TWO ESSAYS ON THE ACCOUNTING TREATMENT FOR INFORMATION TECHNOLGY EXPENDITURES

I. CONCLUSION

Despite substantial effort to establish the overall business value of IT, limited research exists to establish a positive association between IT and profitability measures. This paper uses a theoretical foundation from production economics to propose the capitalization of IT intangibles to overcome a potentially inappropriate accounting treatment to establish a positive and significant relationship between IT and profitability. This study calls attention to the mismeasurement hypothesis introduced by the productivity paradox literature, specifically Brynjolfsson (1993).

This paper also provides and empirical analysis of the proposed theoretical accounting treatment for IT intangibles. The proposed intangible IT capitalization treatment yields statistically reliable amortization rate estimates that can be used to construct useful intangible IT asset variables. The intangible IT adjusted accounting amounts were found to be significantly associated with contemporaneous and intertemporal equity market values, indicating an intangible IT capitalization treatment is implicitly being constructed by investors. However, it appears the constructed IT asset treatment is not fully reflected in the contemporaneous setting, since the constructed intangible IT book value was positive and significant in the intertemporal setting. These results suggest either an under reaction to intangible IT information or an additional risk factor for IT spending.

The widely debated issue of intangible assets has spilled over into an international setting, through talks between FASB and IASB standard setters. Providing better decision making information about the intangible expenditures of firms is a high priority for convergence initiatives, leading standards away from the conservative practices of GAAP. The findings suggest that IT intangible capitalization yields statistically reliable and economically valued information and contextual factors provide additional information for constructing more appropriate amortization estimates for IT spending. The results of this study provide empirical support for the inclusion of contextual based intangible IT assets on the balance sheet despite GAAP mandates. Assessing contextual factors provides statistically significant information about the extent and timing of the future benefits of IT expenditures, overcoming the primary GAAP argument against capitalization. In accordance with standard setting to be decision useful, intangible IT expenditures can be better evaluated by decision makers when more appropriately placed in the financial statements.

The results of this study have implications for managers, standard setters, and researchers. For example, the equity market value assessment of IT value shows the importance of assessing IT expenditures as potential assets because the market already is. Further, the results of this study provide evidence to support the contention that income statement intangibles can contribute to the future value of the firm, leading to a potential capitalization treatment for IT, like R&D studies in the last two decades.

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